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ABSTRACT

This report describes four projects that apply Robert J. Sternberg's theories to various aspects of giftedness and gifted performance. Project 1, a construct validation and educational application of Sternberg's triarchic theory of human intelligence, revealed that students who are instructed and whose achievement is evaluated in a way that matches (at least partially) their profile of abilities will perform better in school than children who are mismatched. Project 2, which examined the construct validity of Sternberg's theory of mental self-government, found that teachers tend to: (1) evaluate more positively students who match their own profile or style and (2) overestimate the extent to which students match their own style of thinking. Project 3, construct validation of Sternberg and Lubart's investment theory of creativity, found that creative individuals are people who "buy low and sell high" in the world of ideas. Project 4, an investigation of Sternberg's pentagonal implicit theory of giftedness, found that society labels people as gifted to the extent that the people meet five criteria: excellence, rarity, productivity, demonstrability, and value. Overall, the four projects reveal the value of a theory-based approach to understanding giftedness. Each of the four parts contains references. (Author/DB)

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# A Triarchic Approach to Giftedness

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1785
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Yale University
New Haven, Connecticut

September 1995
Research Monograph 95126

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## ABSTRACT

This final technical report describes four projects that apply Robert J. Sternberg's theories to various aspects of giftedness and gifted performances. Project I, a construct validation and educational application of Sternberg's triarchic theory of human intelligence, revealed that students who are instructed and whose achievement in evaluated in a way that matches (at least partially) their profile of abilities will perform better in school than children who are mismatched. Project II, which examined the construct validity of Sternberg's theory of mental self-government, found that teachers tend to (a) evaluate more positively students who match their own profile of style, and (b) overestimate the extent to which students match their own style of thinking. Project III, construct validation of Sternberg and Lubart's investment theory of creativity, found that creative individuals are people who "buy low and sell high" in the world of ideas. Project IV, an investigation of Sternberg's pentagonal implicit theory of giftedness, found that society labels people as gifted to the extent that the people meet five criteria—excellence, rarity, productivity, demonstrability, and value. Overall, the four projects reveal the value of a theory-based approach to understanding gitedness.

# A Triarchic Approach to Giftedness

Robert J. Sternberg

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## EXECUTIVE SUMMARY

The four projects described in this final technical report apply Robert J. Sternberg's theories to various aspects of giftedness and gifted performance. They differ in which theories were applied, and, of course, in the methods and data. All of the projects investigate higher level cognition and its ramifications in gifted individuals.

Project I, the main project of the five-year grant period, is a construct validation and educational application of Sternberg's triarchic theory of human intelligence. The project was designed to show that students who are instructed and whose achievement is evaluated in a way that matches at least partially their profile of abilities will perform better in school than children who are mismatched. High school students who were instructed in introductory psychology did in fact perform significantly and substantially better when they were matched rather than mismatched.

Project II investigated the construct validity of Sternberg's theory of mental self-government, a theory of thinking and learning styles. The basic idea is that people differ not only in their abilities, but in how they apply these abilities to the tasks they face. Thus, styles are at the interface between abilities and personality. For example, a legislative person likes to generate new ideas, but is not necessarily adept at generating such ideas. An executive person prefers to work within existing frameworks for ideas—to be told what to do. A judicial person likes to evaluate ideas. The data from four schools suggest that the theory can be quite useful for understanding educational phenomena. For example, it was found that teachers tend to evaluate more positively students who match their own profile of styles. Teachers also overestimate the extent to which students match their own style of thinking.

Project III investigated the construct validity of Sternberg and Lubart's investment theory of creativity. According to this theory, creative individuals are people who "buy low and sell high" in the world of ideas. They generate ideas that are unpopular and often disparaged; they convince other people of the worth of these ideas; and then they move on to other new and unpopular ideas. According to the theory, creative performance represents a confluence of intelligence, knowledge, thinking styles, personality, motivation, and environment. The construct validation was consistent with the predictions of the investment theory.

Project IV investigated Sternberg's pentagonal implicit theory of giftedness. According to this theory, a society labels people as gifted to the extent that the people meet five criteria: (a) excellence, (b) rarity, (c) productivity, (d) demonstrability, and (e) value. In other words, a person needs to excel in something in a way that is rare, needs to produce some kind of product or products, and thereby to demonstrate giftedness, and the product must be of a kind that is valued. Data from two different samples were consistent with the validity of the theory.

The data from the four projects help advance our understanding of different aspects of giftedness, both with respect to persons and products. In particular, they show the value of a theory-based approach to understanding giftedness.

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# A Triarchic Approach to Giftedness

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## PART 1: A Triarchic Analysis of an Aptitude-Treatment Interaction

Can we expand our notions of intelligence in order to include aspects of human functioning beyond those encompassed by conventional psychometric theories of intelligence? If so, is it possible systematically to measure intelligence in these broader ways? And if so, might such new measures shed new light on the existence of aptitude-treatment interactions in the schools? The work reported in this monograph addresses these and related questions.

Part 1 of this monograph is divided into three main parts. First, we briefly discuss traditional ways of measuring human intelligence and their implications for understanding aptitude-treatment interactions (ATI). Next, we present some data on the use of the *Sternberg Triarchic Abilities Test* (*STAT*), as one alternative to traditional psychometric measures of intelligence and as a means for elucidating ATIs. And finally, we discuss some general implications of our findings.

### Traditional Means of Testing Intelligence and Their Implications for ATI

Identifying someone as intelligent implies that he or she has a high level of ability in at least some area. For example, "intelligent students" are ones identified as excelling in one or more academic disciplines, such as reading or mathematics, or in some sort of intellectual activity, such as memory or analysis. Although there is often informal agreement about who is intelligent in some way, there is often disagreement about how best to measure intelligence. In other words, beyond simple academic success, how is one able to detect individuals who should perform well in school or on the job, whether or not they actually do?

Historically, measurement of intelligence in academic settings dates back to Binet and Simon, who developed a scale to distinguish normal children from children deficient in mental ability (Binet & Simon, 1905, 1908). Their scale consisted of a series of 30 tasks of increasing difficulty. Although varied, most of the tasks relied on understanding language and on ability to reason using verbal or nonverbal (spatial and mathematical) materials. This test was later adapted by Terman to create the American *Stanford-Binet Intelligence Scale* (Terman, 1916), and to create similar tests such as the *Wechsler Intelligence Scale for Children-III* (Wechsler, 1991).

After the success of early individually-administered tests at predicting academic performance, group tests of cognitive ability were developed by Burt (1911) and by Otis (1918), the latter for use in testing recruits during World War I. Although these tests continued to require direct answers to questions or solutions to problems, some of them used the multiple-choice procedure. More recently, a further refinement has been introduced in the form of computer-generated tests that adjust the difficulty of the questions

given to the examinee as a function of the success rate at previously generated questions (Mead & Drasgow, 1993). These conventional tests of intelligence tend to be based upon traditional psychometric notions of intelligence (e.g., Binet & Simon, 1908; Spearman, 1927; see Sternberg, 1990, for a review of such notions; Thurstone, 1938), rather than on more recent theoretical notions of what makes someone intelligent.

Current versions of these tests yield an overall score, an intelligence quotient (IQ), for which the average score is 100 and the standard deviation is about 15. The tests also yield subscores: for example, on the *Wechsler* tests, one obtains a total score as well as verbal and performance test scores. IQs are computed on the basis of scores that measure how unusual a person's performance is vis a vis the performance of others in the same age group.

To the extent that the goal of these tests is to predict a wide variety of performances in school, they have unquestionably been partially successful. However, teachers as well as psychologists have increasingly become interested in the identification of children who are intelligent in ways that go beyond IQ (Renzulli, 1986; Richert, 1991; Sternberg, 1985, 1992, 1994; Sternberg & Davidson, 1986). One reason for this trend is that IQ tests leave much of the variance in performance unexplained. Although these tests allow better prediction of performance than is possible without using them, they typically show only a moderate correlation with measures of school performance ($r = .40$ to $r = .70$) (Wigdor & Garner, 1982). The modest to moderate proportions of the variance accounted for by these tests suggests that new tests might improve the level of prediction obtained.

As theoretical work on intelligence has advanced, there has also been an increasing interest in theory-based assessments that can help explain human intelligence, as well as predict potentially intelligent performance in school and other settings. This theoretical work has been of many stripes. Carroll (1993) has extensively factor-analyzed existing data sets to construct a new, three-tier model of intelligence. Hunt (1980) has used cognitive tasks and their underlying models to understand intelligence, as have Jensen (1982), Snow and Lohman (1984), Pellegrino and Kail (1982), and others. Keating (1984) and Ceci (1990) have emphasized the importance of context, and Gardner (1983, 1993) has suggested examining multiple intelligences. The work reported here is in this vein, but is based on a different theory.

Conventional tests of intelligence have yielded what might be seen as somewhat disappointing results when used in studies of ATI. In particular, to the extent that such ATIs have been found, they have tended to be primarily with respect to the general factor (g) of intelligence (Cronbach & Snow, 1977). One interpretation of these results would be that such interactions are limited, few, and far between. Another interpretation, which we begin to examine in this monograph, is that the paucity of ATIs may reflect limitations in the conventional conceptualizations of intelligence as operationalized by traditional psychometric tests of abilities. In particular, we use as a theoretical basis for our research the triarchic theory of human intelligence (Sternberg, 1985).

## Methods

### Participants

The participants in the present study were high school students, ranging in age from 13 to 16, who attended the 1993 Yale Summer Psychology Program (YSPP). The program was advertised through brochures and newsletters distributed to schools in the USA and

abroad. Schools were asked to submit nominations of gifted students to the Program Committee of the YSPP. A selection procedure was based on the students' performance on the *Sternberg Triarchic Abilities Test* (*STAT*), level H, designed for advanced high school and college students (Sternberg, 1993). The *STAT* was sent to schools that placed nominations, where the test was administered to the nominated students.

A total of 199 students (146 females and 53 males) were selected for participation in the summer program of 1993. Of these students, 3 (1.5%) were entering grade 9, 25 (12.6%) were entering grade 10, 77 (38.7%) were entering grade 11, and 94 (47.2%) were entering grade 12. The program participants were fairly widely distributed ethnically (based on students' own reports): 60% European American, 11% African American, 6% Hispanic American, and 17% American from other ethnic minorities. Furthermore, 4% of the students were African African (from South Africa), and 2% "other."

Based on their *STAT* performance, all students enrolled in the program were classified into five different groups. The *STAT* subtest scores were standardized, so they could be compared across different subtests. Students were identified as "high" in an aspect of ability based on their strongest test achievement and their score in respect to group average. Thus, the first three groups included: (1) a group in which students were high in analytical ability ($N = 39$, 19.6%); (2) a group in which students were high in creative ability ($N = 38$, 19.1%); and (3) a group in which students were high in practical ability ($N = 35$, 17.6%). For students to be classified as "high" in analytic, creative, or practical ability, their total score for a given ability was required to be at least a half-standard deviation above the group average and at least a half-standard deviation above their own scores for the other two abilities measured by the *STAT* (e.g., analytic higher than creative and practical). Although the half-standard deviation criterion might sound weak, recall that all students entering the program were first nominated as gifted by their schools. In addition, a "balanced" gifted group was also defined ($N = 40$, 20.1%). For students to be classified as balanced, they had to score above the group average for all three abilities. Finally, the fifth group was comprised of students who scored at or below the group average for all three abilities ($N = 47$, 23.6%). These students were classified as not identified as gifted.

## Materials

### Ability Test

Participants for this study were selected on the basis of scores on the *Sternberg Triarchic Abilities Test* (*STAT*) (Sternberg, 1991a, 1991c, 1993), a research instrument constituting one theory-based alternative to traditional intelligence tests. The test is based on the triarchic theory of intelligence (Sternberg, 1985), which views intelligence as comprising three aspects: an analytical aspect, a creative aspect, and a practical aspect.

In a nutshell, the analytical aspect of intelligence involves analyzing, evaluating, and critiquing given knowledge; the creative aspect involves discovering, creating, and inventing new knowledge; and the practical aspect involves using, implementing, and applying knowledge in everyday contexts.

The test has nine four-option multiple-choice subtests, each comprising four items. The test takes roughly one hour to administer. In addition, the test includes three performance or essay subtests—one emphasizing analytical, the second creative, and the third practical thinking.

The nine multiple-choice subtests represent a crossing of three kinds of process domains specified by the triarchic theory—analytic, creative, and practical—with three major

content domains—verbal, quantitative, and figural. The idea behind this design is to measure the three aspects of processing in content domains that involve different basic abilities. The nine multiple-choice subtests plus the three performance tests are:

1. **Analytic-Verbal** (neologisms [artificial words]). Students see a novel word embedded in a paragraph, and have to infer its meaning from the context.
2. **Analytic-Quantitative** (number series). Students have to say what number should come next in a series of numbers.
3. **Analytic-Figural** (matrices). Students see a figural matrix with the lower right entry missing, and have to say which of the options fits into the missing space.
4. **Practical-Verbal** (everyday reasoning). Students have to solve a set of everyday problems in the life of an adolescent (e.g., what to do about a friend who seems to have a substance-abuse problem).
5. **Practical-Quantitative** (everyday math). Students have to solve math problems based on scenarios requiring the use of math in everyday life (e.g., buying tickets for a ballgame or making chocolate chip cookies).
6. **Practical-Figural** (route planning). Students are presented with a map of an area (e.g., an entertainment park), and have to answer questions about navigating effectively through the area depicted by the map.
7. **Creative-Verbal** (novel analogies). Students are presented with verbal analogies preceded by counterfactual premises (e.g., money falls off trees), and must solve the analogies as though the counterfactual premises were true.
8. **Creative-Quantitative** (novel number operations). Students are presented with rules for novel number operations (e.g., *flix*, for which numerical manipulations differ depending upon whether the first of two operands is greater than, equal to, or less than the second). Subjects have to use the novel number operations to solve presented math problems.
9. **Creative-Figural** (novel series completion). Subjects are first presented with a figural series that involves one or more transformations; they then must apply the rule of the original series to a new figure with a different appearance, to complete a new series.

There are also three essay items, one each stressing analytical, creative, and practical thinking. In the current version, the analytical problem requires students to analyze the advantages and disadvantages of having police or security guards in a school building. The creative problem requires students to describe how they would reform their school system to produce an ideal one. The practical problem requires students to specify a problem in their life, and to state three practical solutions for solving it. Essays are scored for analytical, creative, and practical qualities, respectively, by trained raters.

**Instructional Material**

The text for the course was a pre-publication version of *In Search of the Human Mind* (Sternberg, 1995), an introductory-psychology text comprising 20 chapters. The text covers at a college level the topics typical of introductory-psychology courses.

**Assessment of Achievement**

There were two examinations in the course, a midterm and a final. Both exams comprised multiple-choice items emphasizing primarily recall and simple inference, as well as analytically, creatively, and practically-oriented essays. There were also two homework assignments with analytical, creative, and practical parts. For example, one homework

assignment required students to (a) compare and contrast two theories of depression; (b) propose their own, improved theory, which could be based in part on past theories; and (c) show how they could apply their theory of depression to help a depressed friend. There was also an independent project with analytical, creative, and practical parts.

### Design

Students were selected on the basis of their ability-test score profiles to be either (a) high-analytical, (b) high-creative, (c) high-practical, (d) high-balanced, or (e) low-balanced. They were then placed at random in sections of the introductory-psychology course that emphasized (a) analytical instruction, (b) creative instruction, (c) practical instruction, or (d) memory instruction (control). Thus, some students were matched, and others mismatched with respect to ability patterns and instructional treatment. All students were assessed for (a) analytical, (b) creative, (c) practical, and (d) memory achievement. Thus, participant ability and method of instruction were between-subjects variables, and method of assessment was a within-subjects variable.

### Procedure

Ability tests were sent out to schools from which students were nominated. The tests were administered in the schools, and then returned to us for scoring and data-analysis. Students were then selected for participation in the study on the basis of their ability pattern. They came to the four-week summer program at Yale, where they were housed in a dormitory. Students used a common text and attended common lectures in the morning, given by a psychology professor who had won a university teaching award. In the afternoons, students were assigned to sections. There were eight sections in all, two for each of the four instructional conditions. Although students and their parents signed informed consent forms and thus knew they were part of a study, they did not know exactly what the study was about, nor that it involved ability patterns. Of course, they did not know their test scores nor how the sections were intended to differ. All examinations were administered in class. At the end of the course, participants were debriefed.

## Results

Basic statistics for the *STAT* are shown in Table 1.1. Scores for essays represent an average of two independent raters. These statistics show acceptable levels of mean performance and dispersions around these means, with the exception of creative-quantitative, which was too easy.

Table 1.2 shows intercorrelations between the three subscales of the *STAT* for the multiple-choice and the essay sections separately, and for the three types of skills overall. In keeping with the triarchic theory, the levels of intercorrelation between the three subscales are sufficiently *high* to suggest that there are at least some common mental processes underlying the three kinds of functioning, but sufficiently *low* to suggest the discriminant validity of the three kinds of subtests. Indeed, the correlations among the three aspects of processing are sufficiently low at least potentially to allow differential prediction to school or other performance, although of course other analyses are needed in order to see whether such differential prediction is achieved. One can also see some modality effects: Multiple-choice items tend to correlate better with each other than they correlate with essay items.

Table 1.1

Basic Statistics for the *STAT* M-C: High School Level Means and Standard Deviations ($N = 326$)

| | Analytical* | | Creative* | | Practical* | |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD |
| Verbal | 2.63 | 1.07 | 2.75 | 1.09 | 2.86 | .90 |
| Quantitative | 2.42 | 1.35 | 3.64 | .70 | 2.40 | 1.14 |
| Figural | 2.85 | 1.07 | 2.36 | 1.07 | 2.33 | 1.04 |
| Essays | 2.78 | .73 | 2.54 | .71 | 2.85 | .81 |
| Overall** ($N = 326$) | 7.90 | 2.53 | 8.75 | 2.09 | 8.09 | 2.11 |
| Overall*** (Multiple Choice Plus Essays) | 10.77 | 2.73 | 11.50 | 2.09 | 11.04 | 2.28 |

* maximum score for all subscales and essays was 4.
** maximum score for all overall scales was 12.
*** maximum score was 16.

Table 1.2

Overall Correlations of *STAT* Ability Scores ($N = 326$)

| | Analytic | Creative | Practical |
|---|---|---|---|
| Analytic | 1.00 | .49** | .43** |
| Creative | | 1.00 | .38** |
| Practical | | | 1.00 |

Correlation Between Subtests

| | Multiple Choice Questions | | | Essay Questions | | |
|---|---|---|---|---|---|---|
| | Analytic | Creative | Practical | Analytic | Creative | Practical |
| Multiple Choice Questions | | | | | | |
| Analytic | 1.00 | .52** | .51** | .25** | .08 | .06 |
| Creative | | 1.00 | .47** | .17** | .17** | .05 |
| Practical | | | 1.00 | .17** | .17** | .13* |
| Essay Questions | | | | | | |
| Analytic | | | | 1.00 | .30** | .21** |
| Creative | | | | | 1.00 | .12* |
| Practical | | | | | | 1.00 |

* $p < .05$. ** $p < .01$.

Because we used two different forms of test items (multiple choice and essay) as well as three different content domains within the multiple choice, it was possible to use LISREL (structural-equation) modeling in order to answer a fundamental question. What would be the correlations across the abilities if one held method variance constant? In other words, we want to take out elements of the inter-subtest correlations that are due solely to shared forms of testing. Using such analysis, we found the correlations to be .08 for analytic and creative, .14 for analytic and practical, and .06 for creative and practical. None of the correlations was significant. These results suggest that the three aspects of intelligence have greater independence than it would seem on the basis of correlations of subtests.

Let us now look at the internal-consistencies reliabilities for the test, as shown in Table 1.3. The KR-20 internal-consistency reliabilities of the identification instruments were computed for the multiple-choice items. These reliabilities were .63 for the analytic items, .62 for the creative items, and .48 for the practical items. Given the diversity of the three different kinds of contents and hence of mental representations (verbal, quantitative, figural), and the fact that the subtests were fairly short, very high levels of internal consistency would not be expected. These internal-consistency reliabilities were moderate and at least reasonable.

A principal-components factor analysis was conducted on the *STAT* scores for the 326 individuals who applied to our summer program, as shown in Table 1.4. When we did a varimax rotation, nine specific factors resulted, each factor with an eigenvalue of approximately 1 (1.01, 1.01, 1.01, 1.01, 1.01, 1.00, .99, .99, .98). The pattern of factor loadings for these nine factors shows that one does not necessarily get a general factor when one expands the range of abilities tested on a measure of intelligence. (An unrotated solution will yield a general factor of greater or lesser strength, solely as a property of the principal-components algorithm, which maximizes the amount of variance extracted in the first and each successive unrotated principal component).

Table 1.3

Reliabilities of the *STAT*: High School Level ($N = 326$)

| Multiple-Choice Subtest | Coefficient Alpha |
|---|---|
| Analytical | .63 |
| Creative | .62 |
| Practical | .48 |
| **Essay** | **Inter-Rater Reliability** |
| Analytical | .69 |
| Creative | .58 |
| Practical | .68 |

Table 1.4

Principal-Component Analysis With Varimax Rotation of *STAT* ($N = 326$)

| | I | II | III | IV | V | VI | VII | VIII | IX |
|---|---|---|---|---|---|---|---|---|---|
| A-V | .97 | .04 | .06 | .07 | .07 | .04 | .11 | .14 | .08 |
| A-Q | .10 | .10 | .09 | .05 | .17 | .18 | .21 | .11 | .92 |
| A-F | .05 | .11 | .12 | .02 | .12 | .94 | .13 | .15 | .17 |
| C-V | .15 | .09 | .12 | .12 | .12 | .16 | .08 | .94 | .11 |
| C-Q | .07 | .08 | .97 | .08 | .09 | .11 | .11 | .11 | .08 |
| C-F | .08 | .09 | .10 | .05 | .96 | .12 | .10 | .12 | .15 |
| P-V | .07 | .06 | .07 | .98 | .05 | .02 | .05 | .10 | .04 |
| P-Q | .12 | .12 | .12 | .05 | .11 | .13 | .94 | .09 | .21 |
| P-F | .04 | .97 | .08 | .07 | .09 | .11 | .11 | .09 | .09 |

A = Analytic, C = Creative, P = Practical, V = Verbal, Q = Quantitative, and F = Figural

In a pilot Yale Summer Psychology Program conducted in 1992 ($N = 64$), a variety of tests of abilities was administered. We expected these tests to be related to the *STAT*, and administered them to serve as measures of the convergent and discriminant validity of the *STAT*. Our emphasis was more on convergent than on discriminant validity. Nevertheless, the patterns of results generally make sense in terms of the constructs measured, as shown in Table 1.5.

The lowest correlations of other tests with the *STAT* are generally with the practical subtest, which is the subtest whose content is the most different from that of traditional tests. The test most similar to conventional ones was the Terman *Concept Mastery Test*, followed by the *Watson-Glaser Critical Thinking Appraisal*, then by the *Cattell Culture-Fair Test of g*, followed by quantitative insight problems adopted from Sternberg (1986). The more conventional the test that we used, the higher the test tended to correlate with the analytical subtest of the *STAT* and the lower with the creative subtest. These were only trends, however.

Table 1.5

Concurrent Validities of the *STAT* With Other Ability Tests

| | *Concept-Mastery* | *Watson-Glaser* | *Cattell* | Insight Problems |
|---|---|---|---|---|
| *STAT* | | | | |
| Analytic | .49** | .50** | .50** | .47** |
| Creative | .43** | .53** | .55** | .59** |
| Practical | .21 | .32* | .36* | .21 |

* $p < .05$. ** $p < .01$.

Student course performance was used to measure the predictive validity of the *STAT* in the 1993 summer program. Students in the program were evaluated in three ways: They were given two assignments, a final project, and two examinations (midterm and final). Each of the assessments involved analytic, creative, and practical thinking, as well as use of memory.

For example, one homework assignment asked students to (a) analyze a psychological experiment for strengths and weaknesses (analytic), (b) improve on the experiment (creative), and (c) show how the results of the experiment could be applied in everyday life (practical). The midterm consisted of a multiple-choice portion measuring primarily recall, and three essays: one analytic, one creative, and one practical. The final exam again consisted of multiple-choice and essay sections, differing from the midterm only in the length of the multiple-choice section (it was longer) and the number of essays (three per type rather than one). The independent project required students to come up with their own investigation and to pursue it analytically, creatively, and practically.

Four raters scored all performance assessments (i.e., assignments, exam essays, final project). Each (analytic, creative, practical) part of each assessment was rated for analytic, creative, and practical quality. To reduce redundancy, and to arrive at a purer assessment of each of these abilities, analyses are reported only for ratings matched to assessments (e.g., analytic ratings for the analytic performances, creativity ratings for the creative performances, and practical ratings for the practical performances). Results were similar when all three ratings were used for all three types of performance.

All ratings were on a scale of 1 (low) to 9 (high). Raters met frequently in order to ensure common standards and use of the rating scales. Interrater reliabilities for the four judges are shown in Table 1.6. We judged these correlations to be sufficiently high in combination to permit further analyses on the data.

Table 1.6

Inter-Rater Reliabilities (Intercorrelations) of Quality Ratings of Achievement Measures for Four Judges

| | Analytic task | Creative task | Practical task | Overall tasks |
|---|---|---|---|---|
| Assignments | .63 | .50 | .64 | .59 |
| Final Project | .56 | .40 | .48 | .45 |
| Exams* | .85 | .57 | .71 | .71 |
| Effective Reliability of Quality Ratings for Four Judges (Calculated using Spearman-Brown formula) | | | | |
| Assignments | .87 | .80 | .88 | .85 |
| Final Project | .84 | .73 | .79 | .78 |
| Exams | .96 | .84 | .90 | .90 |

* Cases involving unanswered exam questions were excluded from these analyses.

Simple correlations between the *STAT* and course performance are shown in Table 1.7. The message of these correlations is clear. Subtests for all three processing domains for the *STAT* reliably predict all of the analytical, creative, and practical aspects of course performance. Of course, because the subtests are themselves correlated, there may be redundancy in these predictions. Hence, we need to use multiple regression in order to assess unique incremental degrees of prediction.

The results of stepwise multiple regressions, addressing the question of incremental prediction, are shown in Table 1.8. In this analysis, variables were allowed to enter only if their unique contribution was statistically significant at the 5% level. In every case, at least two variables, and in one case, all three variables, significantly contributed to prediction: the analytical and either or both of the creative and practical scores. Given that courses have traditionally emphasized analytical abilities and are likely to continue to do so, the contribution of the analytical subtests, which are the most like the subtests on conventional tests, is not surprising. It is worth noting, though, that at least one of the other two subtests made incremental contributions to each of the three predictions.

Table 1.7

Correlations of Combined *STAT* Multiple Choice and Essay Scores With Course Assessments

| | | Assignments | | |
|---|---|---|---|---|
| *STAT* Scores | Analytic | Creative | Practical | Overall |
| Analytic | .35** | .28** | .29** | .33** |
| Creative | .30** | .27** | .25** | .30** |
| Practical | .27** | .29** | .23** | .28** |
| | | Final Project | | |
| *STAT* Scores | Analytic | Creative | Practical | Overall |
| Analytic | .37** | .32** | .28** | .36** |
| Creative | .24** | .27** | .22** | .27** |
| Practical | .29** | .15** | .13 | .21** |
| | | Exams | | |
| *STAT* Score | Analytic | Creative | Practical | Overall |
| Analytic | .35** | .33** | .38** | .38** |
| Creative | .29** | .22** | .23** | .26** |
| Practical | .26** | .15** | .21** | .23** |

* $p < .05$. ** $p < .01$.

Note. Total Over all Assessments
Analytic .42**
Creative .33**
Practical .29**

Table 1.8

Stepwise Multiple Regression of Course Performance on *STAT* Multiple Choice Items and Essays

| Dependent Measure | | | *STAT* Score Beta | | |
|---|---|---|---|---|---|
| | *F* Value | $R^2$ | Analytic | Creative | Practical |
| Assignments | 12.41 | .42** | .23** | .19** | .16* |
| Final Project | 16.40 | .40** | .31** | .17* | .07 |
| Exam M-C | 22.79 | .45** | .34** | .20** | .13 |
| Exam M-C & Essays | 21.46 | .44** | .35** | .18** | .12 |

* $p < .05$. ** $p < .01$.

Moreover, there were compelling aptitude-treatment interaction effects, as shown both via contrast analyses and via log-linear analyses. These results are somewhat more salient than those that have sometimes been obtained in the past (see Cronbach & Snow, 1977). The contrast analyses involved assigning differential weights to students according to the match of their instructional assignment to their respective levels of analytical, creative, and practical abilities, and then using these weights to examine predicted patterns of performance on the analytical, creative, and practical tasks completed during the summer program. The results of all the contrast analyses were statistically significant for each of the analytical, creative, and practical tasks, as shown in Table 1.9.

In addition, log-linear analyses were used to test the specific effects of the different afternoon instructional sessions (analytical, creative, practical, and memory instruction) on students with different types and levels of abilities (analytical, creative, practical, high-balanced, and low-balanced students). For the purpose of these analyses we determined the "best" performance group by selecting students whose performance on a given task was at least one standard deviation above the group mean. Then we studied the distribution of the best students, categorizing them as matched (and balanced), mismatched, or other (see Table 1.10). For example, 26 students (14% of the total sample) were rated as at least one standard deviation above the mean on the analytical components of homework assignments. Among these 26 students, 13 (50%) were either analytical students placed in the groups with analytical instruction or balanced students (matched), 5 (19%) were analytical students placed in the groups with other types instruction (mismatched), and 8 (31%) were students with other types of abilities placed in different instruction groups. Based on the frequency counts, presented in Table 1.10, we conducted log-linear analyses (Wickens, 1989), allowing for the main effects of ability and type of instruction, as well as for the corresponding interaction effect. We found statistically significant interaction effects between ability and type of instruction for all of the analyzed contingency tables. Balanced and matched students in all cases were more likely to achieve the best performances (i.e., at least 1 standard deviation above the group mean) on assignments requiring the ability for which they were matched than were either mismatched students or students with other abilities.

Table 1.9

Contrasts on Quality Ratings

| Contrast Coefficient Matrix | | | | | | |
|---|---|---|---|---|---|---|
| **Ability** | Analytic | Creative | Practical | Balanced | Non-gifted | *t*-Value* |
| **Analytic Ability** | | | | | | |
| Contrast Weight | 2.0 | 1.0 | 1.0 | 3.0 | -7.0 | |
| Assignments | | | | | | 4.97 |
| Final Project | | | | | | 5.29 |
| Exams | | | | | | 4.57 |
| **Creative Ability** | | | | | | |
| Contrast Weight | 1.0 | 2.0 | 1.0 | 3.0 | -7.0 | |
| Assignments | | | | | | 3.89 |
| Final Project | | | | | | 3.93 |
| Exams | | | | | | 3.52 |
| **Practical Ability** | | | | | | |
| Contrast Weight | 1.0 | 1.0 | 2.0 | 3.0 | -7.0 | |
| Assignments | | | | | | 4.53 |
| Final Project | | | | | | 2.92 |
| Exams | | | | | | 4.53 |

* for all *t* values, $p < .005$.

Table 1.10

Raw Frequency Counts of Students With High ("Best") Performances in Total, and According to Whether They Were Matched or Mismatched in Terms of Gifted Ability and Instruction

| Abilities Assessed | High Performance | | | |
|---|---|---|---|---|
| | Total (Base $N$ = 179) | Matched/ Balanced* | Mismatched* | Other* |
| **Analytical** | | | | |
| Assignments | 26 (14%) | 13 (50%) | 5 (19%) | 8 (31%) |
| Exams | 26 (14%) | 11 (42%) | 2 ( 8%) | 13 (50%) |
| Final project | 32 (18%) | 11 (34%) | 5 (16%) | 16 (50%) |
| Overall | 29 (16%) | 12 (41%) | 4 (10%) | 13 (45%) |
| **Creative** | | | | |
| Assignments | 34 (20%) | 11 (32%) | 8 (24%) | 15 (44%) |
| Exams | 31 (17%) | 11 (35%) | 5 (16%) | 15 (48%) |
| Final project | 25 (15%) | 8 (32%) | 3 (12%) | 14 (56%) |
| Overall | 32 (18%) | 10 (31%) | 5 (16%) | 17 (53%) |
| **Practical** | | | | |
| Assignments | 34 (19%) | 16 (47%) | 1 ( 3%) | 17 (50%) |
| Exams | 27 (15%) | 12 (44%) | 5 (19%) | 10 (37%) |
| Final project | 27 (15%) | 12 (44%) | 5 (19%) | 10 (37%) |
| Overall | 26 (14%) | 9 (35%) | 5 (19%) | 12 (46%) |

Note. "Best" is defined as at least one standard deviation above the group mean.

* Matched Balanced—Analytical students placed groups with analytical instruction or balanced students.
Mismatched—Analytical students placed in groups with other types of instruction.
Other—Students with other types of abilities placed in different instruction groups.

Using the results of these analyses, we calculated the odds ratios boundaries of the corresponding interaction effects. The results were striking. Even using the most conservative estimates (i.e., the lower boundary), we found that matched and balanced gifted students were significantly more likely to be classified as having the best performances, for all assessments. The most conservative estimates of the odds ratios are shown in Table 1.11.

Thus, the results of both the contrast analyses and the log-linear analyses highlight the importance of coordinating identification, instruction, and assessment in order to best educate students with different types of giftedness, such as those proposed by the triarchic.

## Discussion

Our results suggest that students performed better when they were matched rather than mismatched in instruction vis a vis their.pattern of abilities. Our results suggest that, ideally, schools would expand their instruction and assessment to take into account creative and practical, and not just memory and analytical abilities. Because it is important for all students to compensate for and remediate weaknesses as well as to capitalize on strengths (Cronbach & Snow, 1977; Sternberg, 1994b), all students ideally would receive at least some of all of the kinds of instruction and assessment, not just the kind that matches their ability pattern. But we should know students' ability patterns, and a triarchic abilities test is a start.

A triarchic-based test has certain advantages over traditional tests for evaluating students' potential for academic excellence. Whereas many traditional intelligence tests provide satisfactory measures of intelligence for some individuals in terms of aspects of analytic ability, these tests typically provide little insight into the creative and practical aspects of intelligence (Sternberg, 1984a, 1991c). Yet creative and practical uses of intelligence are often highly valued, both in the classroom and in many, if not most careers.

Table 1.11

Odds Ratios of Belonging to the "Best Performance" Group, Given a Match Between Ability and Instruction (With *t*-Values[1] of the Interaction Effects in Brackets)

| | Assignments | Exams | Final project | Overall |
|---|---|---|---|---|
| Analytic | 16.0 (4.5**) | 9.0 (3.7**) | 5.0 (3.6**) | 9.0 (3.7**) |
| Creative | 3.3 (2.7**) | 6.0 (3.8**) | 3.1 (2.3*) | 3.1 (2.4*) |
| Practical | 6.3 (3.4**) | 10.6 (3.8**) | 10.6 (3.8**) | 5.6 (4.5**) |

* $p < .05$. ** $p < .01$.

[1] Note that *t*-values shown are those of the parameter estimates obtained from log-linear modeling. These parameter estimates were used to calculate the odds ratio.

Because a triarchic test can measure three different aspects of intelligence (analytical, creative, and practical) in four main content domains (verbal, mathematical, figural, and essay contents), it allows students to be identified as intelligent in a variety of different ways. It also allows teachers to identify strengths of students who might otherwise go unnoticed, and potentially to design classroom activities who might allow different students to demonstrate their nontraditional as well as traditional strengths. If teachers use the triarchic theory in their teaching as well as their assessments of intelligence (see Sternberg, 1994b, 1994c), they will potentially allow students to develop a more well-rounded understanding of different subject areas. Students other than "the usual cast of characters" may also be identified as intelligent. In our own study, the nontraditional (creative and practical) sections of the test identified a greater number of minority students as bright than did the more traditional section (analytical).

A test based on the triarchic theory could also be useful for determining where an individual stands with regard to the verbal, quantitative, and figural domains, as well as with regard to essay performance testing. Although other tests assess functioning across a variety of content domains, they primarily do so in the analytic, and not in the creative and practical domains. In sum, then, a triarchic test seems to provide potential incremental validity beyond the types of tests commonly used to measure intelligence, and to be of particular use to those seeking measures of abilities that go beyond those assessed by traditional tests.

Of course, the current version of the *STAT* has some limits: For one thing, it is difficult to measure the creative and practical aspects of intelligence in a paper-and-pencil format, especially via multiple-choice items, and we believe that there is a long way to go in terms of optimal test development. Moreover, the subtests were kept short to minimize testing time, and the test is not standardized. Nor has it been shown to work at all ages or ability levels. As said earlier, we are working with a research form of a test, not a polished instrument. We view the work reported here as work in progress, not as final, and we are currently working to refine our measures of the triarchic constructs.

Furthermore, there are aspects to academic excellence that the *STAT* does not measure, nor should it, according to the triarchic theory. For example, important determinants of academic success include aspects of personality (Cantor & Fleeson, 1994), level of perceived self-efficacy in different academic tasks (Bandura, 1995; Zimmerman, Bandura, & Martinez-Pons, 1992), level of motivation (Ames & Archer, 1988; Deci & Ryan, 1991), mindfulness (Langer, 1993), self-regulation (Borkowski, Carr, Rellinger, & Pressley, 1990; Pinard, 1992), and will power (Corno & Kanfer, 1993), to name but a few other variables that are important to academic success. Better prediction of academic and other kinds of performance will require not just improved measures of intelligence, but also measures of other constructs such as these.

Finally, intelligence is at least partially defined, we believe, in terms of cultural expectations (Csikszentmihalyi & Robinson, 1986; Gardner, 1983, 1993; Granott & Gardner, 1994), and is expressed in real-world contexts, both in and out of school (Okagaki & Sternberg, 1988; Sternberg, 1991b). Thus, a full consideration of intelligence will require, ultimately, understanding of the contexts in which it will be applied.

In sum, the purpose of this investigation was to examine the interaction between ability patterns and school achievement as a function of type of instruction. The results of the investigation show, we believe, at least some promise both for the theory and for further development of the test. At the very least, it appears worthwhile to explore the creative and practical aspects of intelligence in addition to the analytical one, whether through a triarchic theory and test, or by some other means. There is apparently more to intelligence than *g*,

and what more there is to intelligence can have important implications for classroom instruction and assessment. Students achieve better when instruction matches at least in part their pattern of abilities.

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## PART 2: Styles of Thinking in School

Why do certain students seem to flourish with some teachers, and to wither with others? What leads some teachers and students to prefer a lecture format in the classroom, whereas others prefer small discussion groups? Why do some teachers and students seem to prefer multiple-choice and short-answer tests, whereas others prefer essays and projects? All of these questions, we believe, can be addressed by the construct of thinking styles as expressed by students and teachers.

In this section, we present the results of three studies that investigated this construct. Our particular studies are based on the theory of mental self-government (Sternberg, 1988, 1990), although other theories, some of which are described below, have been proposed as well. In particular, we were interested in investigating styles as they relate to the school and as they affect teaching and learning processes.

What, exactly, is a *thinking style*? A style of thinking is a preferred way of thinking. It is not an ability, but rather a preferred way of expressing or using one or more abilities. Two or more people with the same levels or patterns of abilities might nevertheless have very different styles of thinking. Thus, styles of thinking are not in the domain of abilities or in the domain of personality, but at the interface between the two (Sternberg, 1994).

Because the set of related terms like *thinking styles*, *learning styles*, and *cognitive styles* have been used extensively in the literatures of education and psychology, it is important for us to clarify our own use of the term. We suggest that although people do have a profile of preferences in terms of the ways they prefer to think, at the same time, styles can be variable across tasks and situations. A student's preferred style in mathematics, for example, is not necessarily his or her preferred style in a cooking class. Moreover, styles are not fixed, but rather can vary across the life span. For example, the styles that may lead to adaptive performance (either in learning or teaching) at the elementary-school level are not necessarily those that will work best at the advanced graduate level. We believe, and will present data to show, that styles are at least in part socialized, and that they are not, in any absolute sense, "good" or "bad." Rather, they can be more or less adaptive for a given task or situation, and what is adaptive in one setting may not be in another.

As noted above, ours is not the only theory of styles that has been proposed. Grigorenko and Sternberg (1995) have suggested that the literature on styles can be divided into three overlapping partitions.

### Approaches to Styles of Thinking

The first approach is cognition-centered, and the literature is generally referred to as one on cognitive styles. Theorists and researchers in this area sought to investigate "the characteristic, self-consistent modes of functioning which individuals show in their perceptual and intellectual activities" (Witkin, Oltman, Raskin, & Karp, 1971, p. 3). Some of the main styles studied in this literature are equivalence range (Gardner, 1953), and field dependence-independence (Witkin, 1973). Reviews of this work can be found in Kogan (1983) and Vernon (1973).

A second approach to studying styles is personality-centered. The theory of Myers and Myers (1980), based on the work of Jung (1923), would fall into this camp. Myers and

Myers have distinguished among two attitudes, extraversion and introversion; two perceptual functions, intuition and sensing; and two judgment functions, thinking and feeling; and two ways of dealing with the outer world, judgment and perception. Gregorc (1984) has distinguished between two ways of handling each of space and time. Thus, people can be classified as abstract or concrete with respect to space, and as sequential or random with respect to time. Miller (1987, 1991) has proposed a somewhat different taxonomy, distinguishing among analytic versus holistic, objective versus subjective, and emotionally stable versus emotionally unstable individuals.

The third approach, an activity-centered one, tends to focus on styles of learning. These are the theories that have probably had the most direct application in the classroom. For example, Dunn and Dunn (1978) have categorized styles in terms of preferred elements in a learning situation, such as various aspects of the environment (such as sound and light) and various aspects of interaction with the self and others (such as peers and adults). Renzulli and Smith (1978) have distinguished preferred styles of work in the classroom, such as projects, drill and recitation, and peer teaching. A theory that is of the same kind, but more oriented toward the world of work, is that of Holland (1973), who has distinguished among realistic, investigative, artistic, social, and enterprising styles on the job.

Our goal was to build on this work with the theory of mental self-government (Sternberg, 1988, 1994) and tests of the theory as it applies in the classroom. The goal of the theory is to integrate the various approaches described above, and to provide new directions for theory applied to educational practice.

## The Theory of Mental Self-Government

The basic idea of the theory of mental self-government is that people, like societies, have to organize or govern themselves. Thus, the theory addresses the question of how people govern and manage their everyday cognitive activities, within the school and without.

The theory is organized into five major parts: functions, forms, levels, scope, and leaning of mental self-government. Because scope was not used in our studies, we do not describe it further. What, then, is the role of each part in the theory?

### Functions

Just as governments carry out legislative, executive, and judicial functions, so does the mind. The *legislative* function of the mind is concerned with creating, formulating, imagining, and planning. The *executive* function is concerned with implementing and with doing. The *judicial* function is concerned with judging, evaluating, and comparing.

### Forms

The forms of mental self-government resemble forms of government: monarchic, hierarchic, oligarchic, and anarchic. In the *monarchic* form, a single goal or way of doing things predominates. People with a monarchic style tend to focus single-mindedly on one goal or need at a time. The *hierarchic* form allows for multiple goals, each of which may have a different priority. People with this style like to do multiple things within the same time frame, setting priorities for getting them done. The *oligarchic* form allows for multiple goals, all of which are equally important. A person with this style also likes to do multiple things within the same time frame, but has difficulty setting priorities for getting them done. Finally, the *anarchic* form is antisystematic. People with this style tend to eschew rules,

procedures, and formal systems. As a result, they often have difficulty adjusting to the school as a system.

### Levels

Just as governments have more local or more global levels of society with which they customarily deal, so do people. *Local* individuals prefer dealing with details and with concrete issues, whereas *global* individuals prefer to deal with the large picture and with abstractions. Whereas the local person is susceptible to losing the forest for the trees, the global person is susceptible to seeing the forest but not the trees that constitute it.

### Leanings

People, like governments, can have more liberal or more progressive leanings. An individual with a *liberal* style likes to do things in new ways and to have change in his or her life; an individual with a *conservative* style prefers traditions and stability.

The basic idea, then, is that people can be characterized and assessed on each of these styles. People may vary both in their extremity and in their flexibility with regard to the styles. For example, some individuals might be liberal in almost any situation, whereas other individuals might be liberal in certain kinds of situations but conservative in others. Furthermore, a given individual might be strongly liberal, either in specific domains or across domains, or else mildly liberal, again either within or across domains.

The goal of our studies was to operationalize the theory, and apply it to various educational activities, in particular, learning and teaching.

## General Methods

This section describes those aspects of the methods that were common across studies.

### Schools

Teachers and students from four school sites participated in the studies. The schools were (a) a large urban public high school, (b) a prestigious and nationally known preparatory school with a high annual tuition, (c) an elementary-secondary private school with an emphasis on emotional education and a similarly high tuition, (d) a small Catholic elementary-secondary parochial school. The private schools cater to somewhat different clientele. Admission to the first requires very high grades and standardized test scores; the second private school, in contrast, welcomes students who have encountered difficulties in their school careers; the third school comprises students who are virtually all Catholic, and emphasizes religious as well as secular education.

### Participants

In all, 124 students (51 female and 73 male) and 85 teachers (57 female and 28 male) participated in the studies. Of the group of students, 54 were from School A, 11 from School B, 39 from School C, and 20 from School D. Of the group of teachers, 33 were from School A, 15 from School B, 29 from School C, and 8 from School D. Teachers taught either all subjects (at the elementary-school level), history, English, foreign language, social studies, physics, chemistry, mathematics, biology, home economics, physical

education, or business-related subjects. Mean age of participating students was 14.8 (standard deviation, 2.3). Mean age of participating teachers was 37.3 (standard deviation, 11.2). Participation of all students and teachers was voluntary without compensation.

### Measures

We used three basic measures in the studies described below. Examples of items from each measure, as well as internal-consistency alpha reliabilities of subscales (calculated on independent but comparable samples of students and teachers not otherwise involved in these studies), are shown in Table 2.1.

The purpose of having three measures was to have converging operations (Garner, Hake, & Eriksen, 1956) that measured the same constructs. In this way, sources of bias and error associated with individual measures would be reduced (Campbell & Fiske, 1959). Not only did the kinds of measures differ, but who was doing the assessment of whom differed as well. Each of the instruments in the studies was created on the basis of items suggested and evaluated by teachers from various schools in Connecticut.

*Thinking Styles Questionnaire for Teachers* (*TSQT*). This was a 49-item questionnaire in which teachers were asked to assess their styles of teaching on seven subscales (which were not, of course, identified to the teachers): legislative, executive, judicial, local, global, liberal, and conservative. Each subscale had 7 Likert-scale items with an evaluation scale ranging from 1 (low) to 7 (high).

*Set of Thinking Styles Tasks for Students* (*STSTS*). This was a set of 16 different tasks and preference items for students. The tasks and preference items were assumed to map directly onto 11 thinking styles, namely, legislative, executive, judicial, monarchic, hierarchic, oligarchic, anarchic, local, global, liberal, and conservative. Students had to solve problems and make choices, and every response was coded via a scoring map of correspondence between responses and styles. For each scale, the sum of the scores across tasks and preference items was considered to be a measure of the thinking style.

*Questionnaire of Students' Thinking Styles Evaluated by Teachers* (*QSTST*). This was a questionnaire for teachers consisting of 49 items, 7 for each of 7 scales: legislative, executive, judicial, local, global, liberal, and conservative. Items were in the form of a Likert scale with ratings ranging from 1 (low) to 7 (high).

## Study 1: Teacher Styles

The goal of this study was to explore teacher styles as a function of grade taught, number of years of teaching experience, and subject-matter area taught.

### Item Examples

When I am studying literature, I prefer: a) to make up my own story with my own characters and my own plot (*legislative*); b) to evaluate the author's style, to criticize the author's ideas, and to evaluate characters' actions (*judicial*); c) to follow the teacher's advice and interpretations of author's positions, and to use the teacher's way of analyzing literature (*executive*); d) to do something else (please describe your preferences in the space below).

Table 2.1

Examples of Some of the Items and Reliability Coefficients of the Scales of the *Thinking Styles Questionnaire for Teachers, Set of Thinking Styles Tasks for Students* and the *Questionnaire of Students' Thinking Styles Evaluated by Teachers*

| Styles | Sample Items | Reliability |
|---|---|---|
| | ***Thinking Styles Questionnaire for Teachers (TSQT)*** | |
| | | *N* = 103 |
| Legislative | I want my students to develop their own ways of solving problems. | .80 |
| Executive | I like to follow instructions when I am teaching. | .77 |
| Judicial | Teachers should give continual feedback on students' progress. | .93 |
| Local | I like to give my students tests that require exacting and highly detailed work. | .89 |
| Global | I think that teachers must increase the conceptual as opposed to the factual content of their lessons. | .66 |
| Liberal | Each year I like to select new and original materials to teach my subject. | .71 |
| Conservative | I agree with people who call for more, harsher discipline, and a return to the "good old ways." | .73 |
| | ***Set of Thinking Styles Tasks for Students (STSTS)*** | |
| | | *N* = 166 |
| Legislative | | .74 |
| Executive | | .71 |
| Judicial | | .72 |
| Local | | .68 |
| Global | | .63 |
| Liberal | | .75 |
| Conservative | | .78 |
| Monarchic | | .61 |
| Hierarchic | | .64 |
| Oligarchic | | .63 |
| Anarchic | | .59 |
| | ***Questionnaire of Students' Thinking Styles Evaluated by Teachers (QSTST)*** | |
| | | *N* = 149 |
| Legislative | S/he prefers to solve problems in her or his own way. | .91 |
| Executive | S/he is very skilled at taking standardized tests and short-answer or multiple-choice tasks. | .92 |
| Judicial | S/he likes to evaluate her or his own opinions and those of others. | .70 |
| Local | S/he tends to break down a problem into many smaller ones that he/she can solve without looking at the problem as a whole. | .83 |
| Global | S/he often asks questions that are connected with the global context of the problem. | .70 |
| Liberal | S/he grapples with each problem boldly, imaginatively, and resourcefully. | .85 |
| Conservative | S/he sticks to standard rules of doing things. | .88 |

The following is an example of a task to distinguish among oligarchic, hierarchical, monarchic, and anarchic thinking styles. You are the mayor of a large northeastern city. You have a city budget this year of $100 million. Below is a list of problems currently facing your city. Your job is to decide how you will spend the $100 million available to improve your city. Next to each problem is the projected cost to eliminate a problem entirely. In the space on the next page list each problem on which you will spend city money and how much money you will budget for that problem. Whether you spend money on one, some, or all problems is up to you, but be sure your plan will not exceed the $100 million available. Whether you spend all the money to solve one or a few problems or divide the money partially to solve many problems is up to you. You have one additional problem—you are up for re-election next year, so consider public opinion when making your decisions.

Your city faces various problems: 1) Drug problem ($100,000,000); 2) The roads (they are old, full of pot holes, and need to be repaired) ($25,000,000); 3) You have no new land for landfill and you need to build a recycling center ($25,000,000); 4) You need shelters for the homeless ($50,000,000); 5) You must replace subway cars and city buses; you need to buy new ones for the public transportation system ($50,000,000); 6) The public school teachers are demanding a salary increase and they are going to go on strike ($30,000,000); 7) Sanitation workers are demanding a salary increase and they are going to go on strike ($30,000,000); 8) An increase in unemployment has increased the number of welfare recipients ($80,000,000); 9) The AIDS epidemic has created the need for public education on AIDS prevention and you need to build an AIDS hospital ($100,000,000); 10) You need to build a new convention center to attract out-of-state tourists. This could generate additional revenue for the next fiscal year ($70,000,000).

## Results and Discussion

We used two types of data analyses: analysis of variance and correlational analysis. Where we used analysis of variance, we did MANOVA followed up by univariate analyses with Bonferroni corrections of $p$ values.

### Grade Taught

An overall MANOVA showed a significant main effect of grade level taught with respect to the seven styles assessed by the questionnaire, Wilk's Lambda = .49, $F(7,77) = 13.7$, $p < .001$. We therefore did follow-up analyses on the seven individual styles assessed. We found two significant differences. Teachers at lower grade levels were more legislative than teachers at higher grade levels, with respective means of 6.2 and 4.9, $F(1,84) = 13.4$, $p < .001$; complementarily, teachers at the lower grade levels were less executive than the teachers at the higher levels, $F(1,84) = 29.1$, $p < .001$.

We believe there are two plausible, non-mutually exclusive explanations of this finding. The first is that teachers who are more legislative and less executive tend to gravitate toward teaching at the lower grade levels. The second explanation is that when teachers teach at the lower grade levels, they become more legislative and less executive in their style of teaching. In other words, because the lower grades generally allow more freedom of style of teaching, teachers become more legislative. At the upper grade levels, where there is a more rigidly prescribed curriculum and standardized test scores of students are critical for the students' future admissions to college, teachers do not have the freedom to be as legislative, and become more executive.

**Subject Taught**

We divided teachers into three groups on the basis of subjects taught: humanities, sciences, and applied subjects. Because we had 30 humanities teachers, 33 science teachers, but only 5 teachers of applied subjects, we decided to eliminate the applied teachers from this analysis, due to low *N*. A MANOVA revealed a significant effect of subject taught, Wilk's Lambda = .51, $F(7,55) = 9.8$, $p < .001$. We therefore did follow-up univariate analyses of variance. The data showed a significant difference between groups on two of the seven styles assessed. Humanities teachers were more liberal than were science teachers, $F(1,62) = 4.0$, $p < .05$; science teachers were more local than were humanities teachers, $F(1,62) = 16.4$, $p < .001$.

These results seem consistent with the way humanities and sciences are taught in our schools, although not necessarily with anything intrinsic to the disciplines themselves. In the humanities as taught at the secondary and even elementary level, students are generally allowed free expression of ideas through essays, stories, and generally less structured modes of expression. In the sciences, the dominant mode of teaching tends to be factual recall and convergent solution of problem sets where there is a fixed, preset set of answers. Thus, the style of teaching in the humanities seems more oriented toward liberal and nonlocal thinking whereas the style of teaching in the sciences is more oriented toward a more local and less liberal form of expression.

**Duration of Teaching Experience**

We correlated number of years of teaching with scores for each of the seven styles we assessed. We found statistically significant correlations for three styles. More experienced teachers were more executive ($r = .33$, $p < .001$), local ($r = .33$, $p < .001$), and conservative ($r = .44$, $p < .001$) than were less experienced teachers. We also found similar results for age of teachers (which is correlated .87 with duration of experience). However, when duration of teaching experience was partialed out of the correlation between age and style, virtually nothing was left, and no significant correlations remained.

We interpret these results as suggesting that when teachers first start out, they tend to try a lot of new things and to be rather exploratory in the methods of teaching they use and in their ways of relating to students. As the years go by, they discover what they believe to work for them, and become settled into, and possibly entrenched in their ways. This pattern probably applies to many other occupations as well—with older members of a profession forming an establishment of sorts, and preferring more to support existing systems and structures.

**Styles Across Schools**

We were interested in whether the differences we had observed informally among schools would be reflected in mean patterns of teacher styles. So we compared mean profiles of teacher styles across the four schools. The MANOVA revealed a Wilk's Lambda = .52, $F(21,216) = 10.0$, $p < .001$, suggesting the advisability of follow-up univariate analyses.

We found significant differences across schools for six of seven styles. The results of this analysis are shown in Table 2.2.

In the analyses, we used Tukey tests corrected for multiple comparisons to follow up on our univariate *F*s.

Table 2.2

Teachers' Thinking Styles Influenced by the Type of School

| Thinking styles | School A[1] $N = 33$ | School B $N = 15$ | School C $N = 29$ | School D $N = 8$ |
|---|---|---|---|---|
| Legislative | 4.91 | 5.26 | 6.16 | 5.48 |
| Executive | 4.14 | 3.68 | 2.33 | 4.66 |
| Judicial | 5.24 | 5.42 | 4.82 | 5.29 |
| Local | 4.04 | 3.42 | 2.58 | 4.05 |
| Global | 4.94 | 4.87 | 5.05 | 5.48 |
| Liberal | 5.08 | 5.54 | 5.51 | 5.57 |
| Conservative | 3.48 | 2.37 | 1.84 | 3.68 |

Note. The table represents mean scores (maximum score is 7; minimum score is 1) calculated separately for teachers from different schools for the seven styles.

[1] School A: the public high school in community;
School B: the academically-oriented private school;
School C: the elementary-secondary private school with a special program for emotional education;
School D: the elementary-secondary Catholic school

The teachers in the schools differed significantly with respect to the legislative style, $F(3,84) = 13.4, p < .001$. We found that teachers in School C (emphasizing emotional needs of students) was highest, and that both teachers in this school and in the parochial school (D) were higher in this style than were teachers in the schools that were exclusively grades 9-12 (A and B). This result is thus consistent with our previous finding that teachers at the lower grades levels tend more toward the legislative.

The teachers in the schools also differed significantly with respect to the executive style, $F(3,84) = 29.1, p < .001$. Follow-up analyses revealed that all schools differed significantly from one another. The most executive school was the parochial Catholic school (D), followed by the urban public high school (A), the elite preparatory school (B), and the private school oriented toward emotional needs (C). These results suggest that teachers in the urban public and Catholic parochial school are comfortable with greater direction in their teaching, presumably from the administration, than was the case in the other two schools.

The teachers in the schools also differed significantly with respect to the judicial style, $F(3,84) = 3.2, p < .05$. The only significant pairwise comparison was that between the emotionally-oriented private school and the rest, with this private school being less judicial than the others. This result is consistent with the focus of the school, where there are no letter-grade evaluations and where students who might be adjudged as more or less hopeless in the other schools are viewed as challenges rather than insurmountable problems. Indeed, interviews with administrators suggested that many of the students are in this school precisely because other schools did not want to deal with them.

The teachers in the schools differed as well in the local style, $F(3,84) = 17.0, p < .001$. Follow-up comparisons revealed that teachers in the emotionally-oriented school (C)

had lower scores than the teachers in any of the other schools, and that teachers in the prestigious preparatory school (B) were lower than teachers in the urban public school (A) and in the parochical school (D), who did not differ from each other. These results were consistent with the less local approach of the emotionally-oriented school, which was less microanalytic in its approach to teaching and assessment. Although the prestigious private school is at least as grade-oriented as are the other two schools, there is a substantial use of essays, projects, and portfolios in this school, which tend to be less local in character than the assessments in the other two schools, which tend to be more oriented toward conventional short-answer testing.

The teachers in the schools differed in the liberal style, $F(3,84) = 3.0$, $p < .05$. The teachers in the public school (A) were less liberal than the teachers in the other schools. A difference was also observed for the conservative style, $F(3,84) = 28.6$, $p < .001$. The urban public and Catholic parochical schools (A and D) were the most conservative, and the emotionally oriented school (C) was the least conservative, with the prestigious preparatory school (B) in the middle. This pattern was the same as that for the local style, and was consistent with our impression of a relatively conservative style of instruction in the public and parochial schools, and a very avant garde approach in the emotionally oriented school. In the former two schools, relatively little deviation was allowed from preset policies with regard to almost everything pertaining not only to instruction, but to teacher comportment in general.

### School Styles

As we worked in the schools, we observed that not only did teachers seem to have their own individual styles, but so did schools. Each school seemed to have a distinctively different atmosphere. So we decided after the fact to assess the styles of the schools! We had a rater otherwise uninvolved in the study but who is a specialist in educational psychology and who has extensive experience working in schools to evaluate the styles of each of the schools, using as a basis for her ratings school catalogues, curricula, and publicity materials. The teacher knew nothing more about the study than that we needed ratings of each of the schools on the dimensions, which we explained. Each school was rated on a 1-to-7 scale for each of the seven styles considered above. We then did contrasts to evaluate whether there were differences in styles among the schools, based on the ratings.

Six of seven contrasts were statistically significant, as shown in Table 2.3. Because the pattern of results is quite similar to that discussed above, we do not here discuss in detail these further results. At a general level, the results suggest that the data obtained for the teachers in the schools apply globally to the schools as well. Not only do teachers have styles, but so do schools.

## Study 2: Student Styles

### Method

Subjects were all students in the sample described in the General Method section. We used one instrument, the *Set of Thinking Styles Tasks for Students* (*STSTS*). We collected socio-economic data information and other demographic data, students' grades, and scores on the *Iowa Tests of Basic Skills*, where available.

Table 2.3

The Weights and the *Z*(s) of the Planned Contrasts

| Thinking Styles | School A[1] | School B | School C | School D | *Z*(1,81) |
|---|---|---|---|---|---|
| Legislative | -1 | 1 | 1 | -1 | 6.7** |
| Executive | 1 | 1 | -3 | 1 | 83.1** |
| Judicial | 1/3 | 1/3 | -1 | 1/3 | 6.0** |
| Local | -2 | 3 | 3 | -4 | 22.8** |
| Global | -1 | 1 | 3 | -3 | 3.1* |
| Liberal | -3 | 0 | 6 | 3 | n.s. |
| Conservative | -2 | -1 | 6 | -3 | 46.9** |

* $p < .05$. ** $p < .001$.

[1] School A: the public high school in community;
School B: the academically-oriented private school;
School C: the elementary-secondary private school with a special program for emotional education;
School D: the elementary-secondary Catholic school.

**Results and Discussion**

We did a MANOVA on students' styles across schools, and found no significant effect, Wilk's Lambda = .87, $F(33, 325) = 1.11$, $p > .05$. Thus, whereas teachers seem either to gravitate to schools that fit them, or else to become socialized into the styles of their schools, students generally do not have the luxury of choosing a school, and hence cannot usually pick a school that suits them stylistically.

We also did correlational analyses between the styles and some of the demographic data we collected on the students. The goal was to determine whether styles are predictive of various student characteristics. We were particularly interested in correlations of the styles with two demographic variables: socio-economic status (computed on the basis of parental education and birth order. With regard to the former, we found statistically significant correlations between socio-economic status and three of the style variables. In particular, these correlations were with the executive style ($r = -.43$, $p < .001$), the judicial style ($r = -.23$, $p < .05$), and the conservative style ($r = -.47$, $p < .001$). These results speculatively suggest to us the kind of emphasis in lower socio-economic-status households on traditional values, obedience to authority, and possibly authoritarianism that has been found in some past studies (e.g., Adorno, Brunswik, Levinson, & Sanford, 1950; Christie, 1954; Kreml, 1977; Mensch, 1991; Scarr, 1984). These correlations are based on combined father-mother data, and both the father and mother data show the same patterns. Two other trends were obtained for the father data only. These trends were positive correlations between socio-economic status and both the legislative style ($r = .36$, $p < .001$) and the hierarchical style ($r = .25$, $p < .05$).

The birth-order correlations revealed three significant positive correlations: between the legislative and liberal styles and being later-born ($r = .59$ for the legislative style, .41 for the liberal style, and .26 for the hierarchical style). A significant negative correlation was also obtained with the judicial style ($r = -.24$, $p < .05$).

To conclude, the second study showed that students' thinking styles did not differ significantly across schools, and that levels of some styles did correlate significantly with two demographic variables: socio-economic status and birth order. In the third study, we looked not just at teacher or student thinking styles, but at the two in interaction.

## Study 3: Styles of Teachers and Students in Interaction

### Method

In this study, we wished to examine the effect of match versus mismatch of teachers' and students' thinking styles on students' performance. We decided to use an extreme-groups design vis a vis the teachers. Thus, we selected 28 teachers—4 for each of 7 styles—who were extreme with respect to those styles (e.g., 4 who were highly legislative, 4 who were highly executive). We then approached these teachers and asked them to participate in the study, which would involve a substantial time commitment (8-10 hours per teacher filling out styles questionnaires for each of the students involved). Of the 28 we approached, 14 teachers from Schools 1 ($N = 2$), 2 ($N = 5$), and 3 ($N = 7$) agreed to participate. In School 4, none of the teachers were willing to make the time commitment, and so School 4 was dropped from the study. This study also involved a total of 104 students from Schools 1, 2, and 3, of whom 58 were males and 46 were females.

The questionnaire used in this study was the *Questionnaire of Students' Thinking Styles Evaluated by Teachers* (*QSTST*). Examples of some items from this questionnaire are presented above.

### Results and Discussion

Study 2 showed no relation between students' styles and the styles characteristic of their schools. We did find, however, some matching between students' styles and the styles of their teachers, as shown by the correlations in Table 2.4. This table shows the correlations between student and teacher styles for two measures of styles for teachers and students.

If one compares the corresponding correlations in the main diagonal with the noncorresponding correlations off the main diagonal, one finds that the main-diagonal correlations are larger than the off-diagonal correlations in the same row 67 times and not larger 17 times. By chance, on would expect the main diagonal correlations to be larger 42 times. This effect is highly significant by the binomial test, $z = -7.3$, $p < .001$. Thus, there is at least a suggestion that students' styles are somehow socialized by the teachers. An alternative interpretation, of course, would be that students are placed in classes so as to match the styles of their teachers, but this interpretation seems wildly implausible.

Table 2.4

Correlations Between Teachers' and Students' Thinking Styles Scores

| | Teachers' Thinking Styles | | | | | | |
|---|---|---|---|---|---|---|---|
| Students' Thinking Styles | Legislative | Executive | Judicial | Local | Global | Liberal | Conservative |
| Legislative | .341*** | .156 | .459*** | .234** | .376*** | .380*** | -.209* |
| | .403*** | -.050 | .274*** | .122 | .373*** | .304*** | -.322*** |
| Executive | .149 | .402*** | .027 | .247** | -.174 | -.159 | .204* |
| | -.172 | .506*** | -.187 | -.153 | -.161 | -.147 | .047 |
| Judicial | .222* | .236** | .423*** | .296*** | .294*** | .283*** | -.167 |
| | .016 | .150 | .333*** | .083 | .137 | -.147 | -.060 |
| Local | .257*** | .087 | .367*** | .333*** | .146 | .319*** | .247** |
| | .027 | -.149 | .017 | -.162 | .412*** | .109 | .193 |
| Global | .226* | .087 | .367*** | -.327*** | .359*** | .144 | -.249** |
| | .027 | -.149 | .017 | -.133 | .314*** | .088 | -.189 |
| Liberal | .291*** | .138 | .395*** | .174 | .367*** | .342*** | -.198* |
| | .082 | -.034 | .123 | -.022 | .247** | .355*** | -.267*** |
| Conservative | -.350*** | .022 | -.384*** | -.157 | -.400*** | -.399*** | .297*** |
| | -.021 | .120 | .019 | .049 | .079 | .065 | .311*** |

* $p < .01$. ** $p < .05$. *** $p < .001$.

Note. The first line of correlations for each style contains the correlations between the results of the teachers' evaluations of students' thinking styles and the teachers' scores on the thinking styles questionnaire. The correlations on the second line are the correlations between the evaluations of students' thinking styles given by different teachers and the results of students' self-evaluations.

We computed an overall MANOVA with teachers' ratings of students' styles on the seven scales as the dependent variables and teacher group (high legislative, high executive, etc.) as the independent variables, with Wilk's Lambda = .66, $F(42,407) = 4.6$, $p < .001$. These results suggested that teachers were evaluating students in different ways, and hence we followed up the MANOVA with univariate analyses. All Bonferroni-corrected univariate $F$ tests for the various styles rated were also found to be significant, with $F$s ranging from 3.8, $p < .001$ for the liberal style to 8.1, $p < .001$ for the executive style. Mean ratings of the various groups of teachers for each of the styles are shown in Table 2.5.

There was a tendency for teachers in four of the seven groups to evaluate students as closer to their own style than to any other style. In particular, teachers selected for the legislative, executive, liberal, and conservative groups rated students as higher on their own style than on any other style in every case (i.e., for 24 out of 24 types of ratings). Results of pairwise significance tests are shown in the table, but the small number of teachers involved per group requires us to treat these tests with caution.

Table 2.5

Do Teachers Overestimate the Extent to Which Their Students Match Their Own Style?

| | Leg. | Exec. | Jud. | Glob. | Loc. | Lib. | Cons. |
|---|---|---|---|---|---|---|---|
| $F_{st}$[F(6,98)] for ANOVAs | 5.6*** | 8.1*** | 4.3** | 3.8* | 4.0* | 3.9* | 6.1*** |
| | Mean Students' Scores (by Teachers' Groups) | | | | | | |
| Legislative Teachers ($N_{teach}$ = 2; $N_{stu}$ = 35) | 5.2 | 3.4 | 4.3 | 4.4 | 3.9 | 4.8 | 3.3 |
| Executive Teachers ($N_{teach}$ = 2; $N_{stu}$ = 41) | 3.8 | 4.3 | 3.5 | 3.7 | 4.1 | 3.7 | 4.1 |
| Judicial Teachers ($N_{teach}$ = 2; $N_{stu}$ = 37) | 4.5 | 4.1 | 4.4 | 4.2 | 4.6 | 4.4 | 4.0 |
| Local Teachers ($N_{teach}$ = 2; $N_{stu}$ = 23) | 4.8 | 4.3 | 4.7 | 3.4 | 4.5 | 4.4 | 4.6 |
| Global Teachers ($N_{teach}$ = 2; $N_{stu}$ = 28) | 4.7 | 4.1 | 4.5 | 4.4 | 4.1 | 4.7 | 3.9 |
| Liberal Teachers ($N_{teach}$ = 2; $N_{stu}$ = 29) | 4.1 | 3.4 | 3.8 | 3.9 | 3.7 | 4.9 | 3.8 |
| Conservative Teachers ($N_{teach}$ = 2; $N_{stu}$ = 38) | 4.1 | 4.2 | 3.8 | 3.9 | 4.0 | 4.1 | 4.3 |

Note. These analyses compared the groups of students, taking classes with teachers, who differed in their thinking styles. Estimations of students' thinking styles were obtained from the teachers via the *Questionnaire of Students' Thinking Styles Evaluated by Teachers* (Wilks' Lambda = .45; $F(42,407) = 4.6$, $p < .0001$; * $p < .001$, ** $p < .0005$, *** $p < .0001$; for the binary test of means comparison, $z = -4.5$, $p < .001$).

In the judicial, global, and local groups, this trend did not emerge; in each of these groups, teachers rated the students higher on their own style half the time and lower the other half of the time. In other words, teachers in these groups did not tend to rate students as more like themselves than like other patterns of styles.

These results suggest that teachers with at least some styles may have a tendency to view their students as more like themselves (i.e., the teachers) than the students actually are. This tendency may in turn lead teachers to treat the students in ways that would be appropriate for the teachers' own styles, but not necessarily for the students' styles.

Finally, we addressed the question that most centrally motivated the present work. Are students more positively evaluated by teachers when their profile of styles matches that of their teachers? To answer this question, we correlated students' grades as given by their teachers with students' styles as evaluated by the teachers. We were interested in discovering whether students were evaluated better to the extent that there was a match between teachers' and students' style profiles. The data addressing this question are shown in Table 2.6.

Table 2.6

Correlations Between Students' Grades Given by the Teachers With Certain Thinking Styles and Students' Thinking Styles

| | Leg. | Exec. | Jud. | Glob. | Loc. | Lib. | Cons. |
|---|---|---|---|---|---|---|---|
| Legislative Teachers ($N_{teach} = 2$; $N_{stu} = 35$) | .663*** | .247 | .214 | .067 | .345** | .432*** | -.016 |
| Executive Teachers ($N_{teach} = 2$; $N_{stu} = 46$) | .011 | .477*** | -.245 | .313* | .123 | .099 | .288* |
| Judicial Teachers ($N_{teach} = 2$; $N_{stu} = 37$) | .009 | .186 | .577*** | .134 | .334* | .167 | .345* |
| Local Teachers ($N_{teach} = 2$; $N_{stu} = 23$) | .189 | .414* | .489** | .513*** | -.289 | .138 | .299 |
| Global Teachers ($N_{teach} = 2$; $N_{stu} = 28$) | .363* | .134 | .398* | -.368* | .608*** | .375* | .178 |
| Liberal Teachers ($N_{teach} = 2$; $N_{stu} = 23$) | .567*** | .378 | .426* | .113 | .398* | .534*** | .143 |
| Conservative Teachers ($N_{teach} = 2$; $N_{stu} = 38$) | -.145 | .412*** | .356* | .340* | .116 | .118 | .356* |

* $p < .05$. ** $p < .01$. *** $p < .001$.

Of 42 comparisons between correlations in the main diagonal and those off the main diagonal in each row, the correlations in the main diagonal are higher than those off the main diagonal 39 of the 42 times. This effect is highly significant by the binomial test, $z = -5.4$, $p < .001$, suggesting that teachers do indeed evaluate students more highly if there is a match in styles. These results suggest at least the possibility that teachers may confound similarity of students' patterns of thinking to their own patterns of thinking with quality of student thinking. In short, they confuse match in style with achievement.

To conclude, then, the third study has shown that although students tend to match their teachers in style, teachers nevertheless overestimate the extent of this match. They may well teach in ways that are most effective for students with matching styles, because of this overestimation. Moreover, their evaluations seem also to take into account match: Teachers more highly evaluate those students with stylistic patterns like their own.

## General Discussion

Thinking styles are important at the levels of the teacher, of the student, and even of the school. Teachers differ in profiles of styles, and that there are systematic differences with respect to grade taught, subject taught, and length of teaching experience. There are also systematic differences across schools. There are socialization effects on styles, which differ across socio-economic groups, and even across classroom teachers, with students tending to match the stylistic profile of their teachers. Different stylistic patterns also are associated with different levels of achievement, with the strength and in some cases even the direction of the association depending upon the school. Thus, there is no one "right" profile of styles that leads to higher achievement on the part of students. Styles that lead to better performance in one school or even classroom may lead to poorer performance in another.

With regard to the level of the school, we showed that schools seem themselves to have different stylistic patterns, which are reflected in the styles of thinking of the teachers. The data suggest that teachers either seek out a school that matches their stylistic pattern, or else adapt themselves, probably over a long period of time, to styles of thought that are compatible with the styles characteristic of and valued by the school.

These levels interact. Probably the most crucial finding regarding the interaction was that students were viewed by their teachers as achieving at higher levels when the students' profile of styles matched that of their teacher. In other words, teachers appear to value more highly students who are like themselves. Indeed, the data suggested that teachers tend to overestimate the extent to which their students match their own styles.

The ideas of matching teaching and learning styles, and of the relevance of teachers' styles for learners' styles, are of course not new. Lawrence (1982) has recommended developing teaching strategies for the majority group of extraverted-sensing children, and then creating more individualized approaches to the smaller number of introverted and intuitive children. Teachers who report intuitive-thinking and intuitive-feeling as the preferred learning styles of their students tended to prefer teaching with sensing-feeling and sensing-thinking styles. Huelsman (1983) concluded that this lack of congruity could be detrimental to teacher effectiveness and might be a factor in teacher stress, job dissatisfaction, and decision to leave the profession.

The results presented here suggest that styles need to be considered in the teaching-learning process, and that the theory of mental self-government provides one basis for such a consideration. In particular, addressing the question of which students are gifted requires considering whether students can match their styles flexibly to a given task at hand, as well whether a teacher will recognize a student as gifted if the student's profile does not closely match the teacher's.

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## PART 3: An Investment Approach to Creativity: Theory and Data

What enables a person to be creative? Why do some people generate novel ideas and pursue them while others join the crowd with humdrum contributions? We suggest that specific aspects of six resources—intellectual processes, knowledge, intellectual styles, personality, motivation, and environmental context—all contribute to creativity (Sternberg & Lubart, 1991, 1992, 1995). The cognitive resources work together with the conative and environmental ones to form an individual's "investment" in creative enterprise.

In any number of domains, a person may apply the six resources to initiate a project and bring it to fruition. For creative work, we propose that the choice of domains, projects, and ideas for those projects will involve a basic investment strategy of "buying low and selling high." Buying low means pursuing ideas that are unknown or at least slightly out of favor but that have growth potential. A person can buy low in terms of both the primary idea for a project and the secondary ideas needed to develop the product. Buying low inherently links risk-taking to creative performance. Selling high involves presenting one's work and moving on to new projects when an idea or product becomes valued and yields a significant return. Analogous to stock-market investment success, sometimes creativity fails to occur because a person puts forth ("sells") an idea prematurely, or holds an idea so long that it becomes common or obsolete. We suggest that selling high is important for creative success on an individual project and for a career of creative work.

In addition to the "buy low—sell high" theme, the investment metaphor highlights aspects of the definition and judgment of creativity. First, the evaluation of both financial worth and creativity involves social consensus. A stock is valuable, in part, because investors collectively desire to possess it. A product is labeled creative at a point in time because appropriate judges collectively agree on this evaluation (Amabile, 1982). Previous theoretical and empirical accounts of people's conceptions of creativity suggest that novelty or statistical rarity, appropriateness, and high quality are the main criteria for judging creative performance (Amabile, 1982; Jackson & Messick, 1965; MacKinnon, 1962; Sternberg, 1985b, 1988a). Second, the investment metaphor points out the importance of concentrating the evaluation of creativity on *observable products*. When evaluating financial investments, the measurement of performance is tangible, namely, monetary gain. A potential stock investor who has good ideas but who does not participate in the stock market is not a successful investor in stocks. In our view of creativity, a similar distinction exists between latent creative potential and creative performance. Our investigation of the investment approach focuses on creative performance—creativity that is actually manifested in some kind of overt form (see Albert, 1983). Third, the investment approach highlights that there is a continuum of creative performance as there is a continuum of risk and profit in the financial realm.

As with any metaphor between disparate subjects, there are points of correspondence, as we have been noting, and points of non-correspondence, which also bring insights. One example of the differences between the investment and creative realms is the starting point for each endeavor. Financial investors generally buy into existing stocks or other instruments. For creative work, people may join an existing field or a genre, but must also generate the specific project or starting ideas. Another example involves the source of the "value added" after buying into a stock or idea, respectively. The financial investor usually monitors a stock, which may gain in value because the business or economy as a whole succeeds; the investor does not actually go to work for the company. For creativity, however, the individual must roll up his or her sleeves, apply the cognitive, conative, and environmental resources to the problem, push the project toward a final

product, and sometimes promote the product to win acceptance. Thus for creative work, an individual's resources are actively applied throughout a project whereas, in the financial realm, an investor uses his or her resources primarily to make just the "buy" and "sell" decisions.

To conclude our sketch of the investment approach, we turn to a brief description of the cognitive, conative, and environmental resources that a person can invest in a project and the manner in which these resources combine (see Sternberg & Lubart, 1991, for details). We propose that the six resources described below can lead a person to buy low, develop an innovative project, and sell high.

## Six Resources for Creativity and Their Confluence

Problem definition (or redefinition) and insightful thinking are vital to creative performance (Davidson & Sternberg, 1984; Getzels & Csikszentmihalyi, 1976; Sternberg, 1985a). Getzels and Csikszentmihalyi's (1976) seminal research on problem finding showed that art students who produced highly original still-life drawings spent longer periods of time formulating their compositions than less creative peers. Creative work often involves taking an existing problem and redefining it by approaching the problem from a new angle. The insight processes of selective encoding, comparison, and combination are hypothesized to facilitate problem redefinition and problem solution. Selective encoding occurs when a person notices the relevance of information to a task. When Fleming noticed the bactericidal properties of the penicillium mold that had ruined an experiment, he had a selective-encoding insight. Selective comparison involves the judicious use of analogies and metaphors to conceptualize and complete a task. Kekulé, for example, allegedly used a dream of a snake biting its tail to aid him in discovering the ring-like structure of the benzene molecule. Selective combination is the meaningful synthesis of disparate information. Darwin synthesized into a unified whole disparate facts that served as a basis for his theory of natural selection. Analogously, in investing, the successful investor must selectively encode information others do not see as relevant, compare the current case to other investment situations, and synthesize the implications of this information to make the best investment decisions.

Knowledge, the second resource, is necessary to make an informed creative contribution in any domain. Knowledge provides a large part of the raw material on which intellectual processes operate. Knowledge of the "state of the market" in a domain helps a person to avoid reinventing ideas or products that society has already experienced. Knowledge also allows a person to be contrarian—to move away from the popular trends—as successful investors often do in financial markets (Dreman, 1982). With further benefits to creative performance, knowledge helps a person to produce high quality work, to notice and use beneficial chance occurrences, and to devote greater cognitive resources to the processing of new ideas. Given these benefits of knowledge, it is important to note, however, that experts operating on knowledge-rich tasks may become entrenched in a standard or "correct" way of approaching a problem (Frensch & Sternberg, 1989; Langer, 1989). For creativity, therefore, very high levels of knowledge can be detrimental (Simonton, 1984, Sternberg & Lubart, 1991).

Intellectual styles, the third resource, refer to preferences in using one's intellectual skills. Certain intellectual styles facilitate the application of intellectual processes and knowledge by directing an individual toward problem approaches where novelty can occur. Based on a model of mind as mental self-government, three of the style clusters are called legislative-executive, conservative-liberal, and global-local (Sternberg, 1988b). People with a

legislative style prefer work that allows them to make new rules and structures, whereas those with an executive style prefer to apply their thinking skills to the execution of tasks by following rules. A preference for sequential completion of tasks one at a time, the monarchic style, often co-occurs with the executive style. The conservative-liberal styles contrast those with a proclivity for tasks that involve old approaches with those preferring new approaches. Finally, the global style refers to people who prefer to focus on the broader, general aspects of a task whereas the local style describes those who prefer detail-oriented work. An individual can be characterized by a combination of styles reflecting person-situation interactions (Cantor & Mischel 1979), but one style may dominate over others for a given individual. The legislative, liberal, and global styles are hypothesized to make positive contributions to creative performance. The executive, conservative, monarchic, and local styles are predicted to affect creativity negatively.

In terms of the creative personality, we identify five attributes as essential. Each of these attributes helps the cognitive resources to be used effectively. The first, tolerance of ambiguity (Barron & Harrington, 1981; Golann, 1963), is necessary during those periods of creative endeavor in which things are not quite fitting together, but in which premature closure would prevent the intellectual processes from having a sufficient opportunity to get a handle on the problem. The second attribute, perseverance (Golann, 1963; Roe, 1952), is essential in any kind of contrarian efforts where one is going against entrenched ideas and against those who have a stake in the existing order. Intellectual processes and knowledge often need to be applied repeatedly to solve a problem. Without perseverance, the problem-solver may very well become tired and stop the cognitive work early. Third, a willingness to grow becomes important as one attempts to go beyond one's past knowledge and previously successful uses of intellectual skills to make new ones that are genuinely novel. Fourth, a willingness to take risks (Glover, 1977; McClelland, 1956) is emphasized in our investment approach. During creative work, there is a potential for gain (internal and external rewards) or loss (e.g., time, energy, criticism) and the outcome is uncertain. A general principle of investment is that, on average, greater return involves greater risk. The link between risk-taking, cognitive resources, and creative performance is developed in detail later in the chapter. Finally, the fifth attribute is individuality and a supporting courage of one's convictions (Amabile, 1983; Barron & Harrington, 1981; Dellas & Gaier, 1970; Golann, 1963; MacKinnon, 1962, 1965). One needs to value one's novel cognitions and the differences between these cognitions and other people's ideas. To achieve creativity, a person needs to believe in novel ideas even if they go against the crowd's opinion. These aspects of personality are viewed as necessary for the maintenance of high levels of creative performance over long periods of time.

Closely related to personality characteristics is the motivation to use intellectual processes, knowledge, or intellectual styles for creative purposes. In the financial realm, "money makes the world go around." For creative work, intrinsic rewards such as realizing one's potential and satisfying one's curiosity have often been viewed as important driving forces for creativity (Amabile, 1983; Crutchfield, 1962; Golann, 1962, Rogers, 1954). These motivators share a common feature—they all tend to focus attention on the task, which concentrates the effect of whatever cognitive resources are available. Goal-focusing motivators, in contrast, lead people to see a task as a means to an end. If the goal, which may be money, recognition, or an intangible reward, remains salient during task completion, then creative performance suffers because attention is drawn away from the task itself. Thus, we emphasize the way in which motivation focuses attention (task vs. goal) rather than the specific motivator. We suggest that, at moderate levels, motivators (both intrinsic and extrinsic) will be most effective for creativity because people will have a desire to work and be able to maintain a focus on their work. Thus, in accord with the Yerkes-Dodson principle, motivation is hypothesized to bear an inverted-U relationship to creativity.

The final resource for creativity is the environmental context. Environments can provide physical or social stimulation, either of which helps new ideas to form by "jump starting" a person's thinking processes. Environments also differ in the extent to which creativity is fostered (Amabile, 1983; Lubart, 1990; Rubenson & Runco, 1992; Simonton, 1984). The earliest inklings of new ideas, which Finke, Ward, and Smith (1992) call "preinventive forms," need an atmosphere that permits and encourages further idea growth and developments. When conformity is valued, new ideas may be squelched as soon as they are conceived. In investment terms, these conditions would constitute a "bear market" for creative work. In a third role, social environments provide a subjective evaluation of a product's creativity or an individual's creative performance. For example, the work of a young poet could be considered very creative by her peers, but not by literary critics, who might regard the poetry as too offbeat. Thus, the environment sets standards for creative products that individuals may come to internalize as part of their cognitive processes.

A confluence of resources is also necessary. The combined contributions of the individual resources plus interactions among the resources lead to a proclivity for "buying low" and achieving creative performance (see Sternberg & Lubart, 1991). The nature of the resource confluence may vary with the specific domain and task that is involved.

Taken together, we believe that these ideas on the conceptualization of the resources and their confluence themselves represent an integrative approach to creativity. We have attempted to combine the strongest elements of specialized and alternative theories using a new investment metaphor and confluence hypotheses. In particular, the investment approach draws on Amabile's (1983) componential model of creativity, Csikszentmihalyi's (1988) system approach, Getzels and Csikszentmihalyi's (1976) research on problem finding, and Walberg's (1988) ideas on creativity and "human capital."

The investment approach also connects with Finke, Ward, and Smith's (1992) work on creative cognition. The creative cognition approach focuses on the information processes and structures that lead to creativity. Similar to the investment view, creativity is seen as the result of several mental processes that are used to generate and develop new ideas. Also, Finke, Ward, and Smith (1992) mention the importance of motivation, overcoming a fear of failure, and personal involvement on a task, which leads to perseverance and a conviction in one's ideas. Unlike the investment approach, however, creative cognition work (as the label indicates) concentrates on the cognitive side of creativity. We balance our attention between cognitive and non-cognitive (personality, motivation, environment) resources. Thus, one could view the work on creative cognition as an extended and a specialized treatment of the cognitive portion of creativity, compatible with our more general multivariate approach.

We will expand on the potential links between creative cognition and the investment approach after considering two preliminary empirical studies conducted within the investment approach. The first study focuses on the cognitive and conative resources for creative work. The second study provides an in-depth look at cognitive risk-taking and the concept of buying low and selling high.

## Study 1: Testing the Investment Resources for Creativity

Although some recent work has begun to acknowledge that different aspects of creativity are best studied together (Csikszentmihalyi, 1988; Gruber, 1981; Hill, 1990; Rossman & Horn, 1972), previous empirical work has often treated the antecedents of creativity in relative isolation from each other. For example, a large literature base explores

the connection between creativity and intelligence. However, this work has remained separate from other studies on personality and creativity (see Barron & Harrington, 1981). The present research simultaneously studies multiple resources of the investment approach. We seek to describe the contribution to creativity of each resource alone *and* in the context of the other resources. For example, we explore how aspects of intelligence relate to creative performance and then whether the variability in creative performance that intelligence "explains" is different from the variability that the other resources "explain." We hypothesize that each resource will uniquely contribute to creative performance. The resources will also contribute in ways that overlap statistically with other resources and can not be isolated at this time. The relative contribution of each resource to creative performance depends on three variables: (a) the general importance of the resource for creativity (e.g., intellectual processes may be more important than knowledge), (b) the specific requirements of the creativity task (e.g., short-term tasks may decrease the importance of cognitive style or personality), and (c) the extent to which each resource is operationalized and measured well. With these points in mind, the findings we report should be considered suggestive rather than definitive.

The present research, with its multivariate design, also allows us to examine potential interactions between the resources for creativity. We hypothesize that high levels on two or more resources (such as intellectual processes and knowledge) may boost creativity more than does the simple additive effect of the individual resources.

Before turning to the methodology and results, we want to note that the focus of the current study is on the person-centered resources for creativity (intellectual processes, knowledge, intellectual styles, personality, and motivation)—thus, this first study does not directly address the environmental resource. Also, the present study uses a sample of laypeople to test the investment approach (see also Finke, Ward, & Smith, 1992). Others, such as Gruber (1981), have examined the lives of extremely creative people (e.g. Charles Darwin). The investment approach, presented above, should apply to all levels of creative achievement. There are large- and small-scale investors in both the financial and creative realms. However, the use of a sample of laypeople focuses the current test on more typical, everyday-levels of the creative-performance continuum.

## Method

Our subjects for the primary phase of the study consisted of 48 people from the New Haven, CT area (24 males, 24 females). The mean age of the sample was 33.40 years ($SD$ = 13.79), with a range of 18 to 65 years. Fifteen additional New Haven subjects (8 males, 7 females) judged the creativity of the work produced in the first phase. These raters had a mean age of 41.07 years ($SD$ = 13.02) and ranged in age between 21 and 70.

Our study employed multiple measures of creative performance and of the resources, which were chosen to reflect both the investment approach and alternative perspectives. The materials consisted of (a) creativity tasks, (b) cognitive tests designed to measure the intellectual processes relevant to creativity, and (c) self-report measures pertaining to the knowledge, intellectual styles, personality, and motivation resources of the investment framework.

Drawing, writing, advertising, and scientific tasks were composed to allow a broad assessment of creative performance. These tasks involve the production of substantive products that can exhibit a range of creativity. The tasks have a parallel form across the four domains and include topic selection as an integral part of the creative process. Amabile, (1983) and others have used similar types of tasks (e.g., collage-making and poem-writing) to measure creative performance.

The materials for each task consisted of a list of topics and an array of supplies (e.g., pens, paper, pastels). Some drawing topics were "hope," "rage," and "earth from an insect's point of view." Examples of topics used for the other domains were: "Beyond the Edge" and "The Octopus's Sneakers" as titles to be expanded into stories, "bowties," "brussels sprouts," and "the IRS" as topics for television commercials, and "How could we detect aliens among us?" as an open-ended scientific problem. Three to ten topics were provided for each domain.[1]

Four tests of intellectual ability were used as convergent measures of the investment approach's intellectual processes resource. The measures were: (a) the *Stroop Color and Word Test*, individual form (Golden, 1975) to measure selective encoding, (b) the Letter Series Test (Thurstone, 1962) to measure induction, (c) the *Culture-Fair Test of g*, Scale 3, Form A (Cattell & Cattell, 1963) to measure fluid intelligence, and, (d) a *Coping with Novelty* test designed for this study to measure selective encoding, combination, and comparison skills. The *Coping with Novelty* test consisted of 7 insight problems, 17 verbal and 13 figural problems that involved unusual and counterfactual reasoning, and 10 verbal learning from context problems (interitem reliability = .89). These items were drawn from previous research on the triarchic theory of human intelligence (Sternberg, 1980, 1985a, 1986)

Knowledge was assessed with a biographical questionnaire concerning educational history, knowledge level, and activities in the domains studied. For knowledge level, subjects were asked to compare their knowledge in a domain with an average person's knowledge. For relevant activities, subjects were asked how often they engaged in drawing, painting, writing short stories, writing poetry, looking at advertisements, selling products, conducting science experiments, electronics, working on social problems, plus other activities.

Two instruments, the *Intellectual Styles Questionnaire* (*ISQ*), an operationalization of Sternberg's (1988b) theory of mental self-government, and the *Myers-Briggs Type Indicator* (*MBTI*), Form G (Myers & McCaulley, 1985), were used to assess intellectual styles. The *Intellectual Styles Questionnaire* (*ISQ*) has 130 items measuring thirteen thinking styles, including the legislative, executive, monarchic, conservative, liberal, global, and local styles specified in the investment approach. A sample item measuring the global style is: "When working on a project, I care more about its general impact than about the details of it." Previous research on the *ISQ* has also shown adequate scale reliability and construct validity (Martin, 1988). The *MBTI* provides convergent validity with its intuitive—sensing style dimension, which is related to the investment framework's conception of styles.

A wide range of personality characteristics was measured by the *Adjective Check List (ACL)* (Gough & Heilbrun, 1983) and the *Personality Research Form (PRF)*, Form E (Jackson, 1984). The *ACL* provides a list of adjectives that the subject may check as self-descriptors. The *PRF* uses brief statements of behaviors that the subject may find indicative. These instruments provide converging measures for the personality resource.

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[1] The topics for each domain were: Drawing: a dream, a quark, hope, rage, pleasure, earth from an insect's point of view, contrast, tension, motion, beginning of time; Writing: Beyond the Edge, A Fifth Chance, Saved, Under the Table, Between the Lines, Not Enough Time, The Keyhole, The Octopus's Sneakers, 2983, It's Moving Backward; Advertising: double-pane windows, brussels sprouts, Internal Revenue Service (portray positive image), broom, iron, cufflinks, bowties, doorknobs, sugar substitute; Science: Detecting whether aliens are living among us, Determining if someone has been on the moon in the past month, Devising a way for the SDI "star wars" system to destroy real missiles but avoid empty decoy missiles sent to overload the defense system.

Motivation was assessed by a motivational questionnaire composed for this study and the *Creative Motivation Scale* (Torrance, in press). The 50-item motivational questionnaire was constructed on the basis of previous experimental work (see Amabile, 1985); subjects used a 7-point scale to rate how well domain-specific statements like "I would write a short story to challenge myself" described them. The "intrinsic" motivations of relaxation, self-expression, gaining insights, enjoying order in a product, personal challenge, and enjoying a sense of accomplishment and "extrinsic" motivations of money, impressing others, fulfilling external expectations, and obtaining a future job were assessed across artistic, literary, advertising, scientific, and general-life domains. Items were standardized and used to form intrinsic (6 items), extrinsic (4 items), and comprehensive motivation scales (10 items) for each of the domains (15 scales in total). The scales showed high interitem reliability with a median alpha of .80. The *Creative Motivation Scale* contains 28 true-false behavioral statements regarding intrinsic motivation and other creativity-relevant motivations. The Creative Motivation Scale was included for comparative purposes.

Subjects completed the creativity tasks and resource measures during the course of three two and one-third hour sessions. The sessions occurred, on average, two days apart. The first session began with the drawing, writing, advertising, and scientific tasks, which were presented in counterbalanced orders across subjects. As described above, each task involved (a) the selection of a topic from a list of possible topics, and (b) the creation of a product. Subjects worked individually and were encouraged to "be imaginative" and to "have fun." Subjects worked on the drawing and writing tasks for 20 minutes each and the advertising and scientific tasks for 10 minutes each. After completion of these four tasks, the *Intellectual Styles Questionnaire*, *Adjective Check List*, and *Stroop Color and Word Test* were administered. In the second session, each subject received the drawing, writing, advertising, and scientific tasks in a new sequence. This time, however, subjects chose a new topic from each task list and then proceeded. Following these tasks, subjects completed the knowledge questionnaire, Torrance's *Creative Motivation Scale*, the motivational questionnaire, the *Myers-Briggs Type Indicator*, the letter series test, and the *Culture Fair Test of g*. The third session consisted of the *Coping with Novelty* test and the *Personality Research Form*. In all sessions, subjects occasionally shared the experimental testing room.

Our creativity rating procedure was modeled on Amabile's (1983) consensual assessment technique, with the exception that peer judges were used. Peers, rather than experts, were chosen to be raters because peers are the most likely audience for laypersons' work and peers typically evaluate each others' work. Our peer raters worked individually and were asked to use their own definition of creativity. They judged each product on a 1 (low creativity) to 7 (high creativity) point scale. The need for raters to judge products that varied on topic choice made the rating task more difficult than if all products were on the same topic. However, the presence of multiple topics in a set of products to be judged is characteristic of many, if not most, real-world judgement situations and interjudge reliabilities were high. Raters reported that they judged the products against each other and use some external standards as well. Following the creativity ratings, a single random selection of 24 pieces from each product set was presented for further rating. The subset of products from each domain was rated for novelty, aptness to the topic chosen, aesthetic value, integration of disparate elements, technical skill, and perceived effort employed by the creator.

## Results and Discussion

The presentation of the results for this first study is divided into three sections. The first section describes aspects of creative performance: descriptive statistics, criteria used by

raters, and consistency over time and domain. The relationships between individual resources of the investment approach and creative performance are reported in the second section. In the final section, the confluence of resources is addressed.

**Aspects of Creative Performance**

The creativity score for each product was the mean creativity rating given by 15 raters. The mean creativity ratings for the eight products generated by each subject (two drawings, two writings, two advertisements, two scientific solutions) were all close to the 4.0 midpoint of the rating scale ($m$ = 3.68 to 4.22), demonstrating that neither a ceiling nor a floor effect occurred. Standard deviations were slightly less than one point on the rating scale ($SD$ = .78 to .91). For each subject, a composite creativity score was generated for each domain by averaging the two products from the domain.[2] These scores are referred to simply as the "drawing," "writing," "advertising," and "scientific" creativity scores. The mean creativity score across all four domains is termed the "overall" creativity score.

The interjudge reliabilities (alpha coefficients) of the ratings for the various domains ranged from .81 to .89, demonstrating high interjudge consistency (see Amabile, 1982). For the overall creativity score the mean interjudge correlation was .43 and the reliability was .92. We examined raters' implicit criteria for creativity by gathering additional ratings on a subset of 24 products from each task domain. Each product was characterized by a creativity rating and ratings on the dimensions of novelty, aptness, aesthetic value, integration of disparate elements, technical goodness, and effort exhibited. The specialized ratings, in general, correlated significantly with creative performance ratings and with each other. Of primary interest, creativity ratings correlated .65 ($p < .001$) with novelty ratings, .49 ($p < .001$) with aptness ratings, and .57 ($p < .001$) with technical goodness ratings. Novelty ratings were relatively independent ($r$ = .09, n.s.) of aptness ratings and correlated .37 ($p < .001$) with technical goodness.

Based on theoretical definitions and previous research (Amabile, 1982), a hierarchical forward regression was performed on the raters' data. Novelty and aptness ratings were entered first as predictors of creativity ratings. With novelty ($\beta = .62$, $p < .001$) and aptness ($\beta = .43$, $p < .001$) in the model, 61 percent of the variance in creativity ratings was explained ($F(2,93) = 73.21$, $MSe = .25$, $p < .001$). Integration ratings then entered as a third significant predictor variable. This final model explained 70 percent of the variance using novelty ($\beta = .40$, $p < .001$), aptness ($\beta = .15$, $p < .05$), and integration ($\beta = .47$, $p < .001$), ($F(3,92) = 71.67$, $MSe = .19$, $p < .001$). Separate regressions by domain supported the generalizability of the overall analysis to writing, advertising, and scientific products. In the drawing-product analysis, aesthetic value rather than integration entered as a third significant predictor of creativity ratings.

How stable was creative performance? A repeated-measures analysis of variance across time and domain showed no significant mean differences for the creativity of work produced during session one and session two. Correlations across time suggest moderate stability. The correlations between the products within each domain were: .37 ($p < .05$) for drawing 1 with drawing 2, .63 ($p < .001$) for writings, .65 ($p < .001$) for advertisements, .52 ($p < .001$) for science, and .67 ($p < .001$) for overall creative performance between sessions. While all of these correlations across time are significant, some fluctuations in creative performance obviously occur. We believe that these fluctuations are inherent to creativity, and derive from day-to-day changes in the resources that lead to creative performance. The drawing, writing, advertising, and science creativity scores used throughout this study provide

[2] One subject was missing a science product for time 2. This subject's scientific creativity score equaled the score for the first science project.

a more stable estimate of creative performance than individual products because the domain scores represent the mean performance on two occasions.

There was a significant difference in rated creativity across the four domains, $F(3,138) = 5.51$, $MSe = .69$, $p < .01$. The mean creativity ratings for the drawings were 4.13, for the writings 4.14, for the advertisements 3.91, and the scientific products the mean was 3.71. A contrast showed that the science domain was significantly lower than the drawing and writing domains. These mean differences may reflect subjects' differential familiarity with the domains.

Addressing the issue of domain-specificity of creative performance, Table 3.1 presents the correlations across the domains. These ranged from .23 (n.s.) to .62 ($p < .001$) with a median correlation of .37 ($p < .01$). The results suggest that creativity is moderately domain-specific; however there is more overlap between domains than would be expected just by chance. Others, such as Runco (1987) who studied children's self-reported creative achievements across several domains, also find that creativity is somewhat but not completely domain specific. This balance makes sense within our investment approach because some resources such as intellectual processes may apply widely across domains (leading to generalized creativity) but other resources (such as the personality trait of risk taking) may be more domain specific, especially for advanced levels of creative work (Sternberg & Lubart, 1993).

## Person-Centered Resources and Creative Performance

### Intellectual Processes

The *Culture Fair Test of g* (IQ), series completion test, and *Coping with Novelty* test all correlated strongly with creative performance ($r = .41$ to $r = .68$, $p < .001$). These tests required selective encoding, comparison, and combination processes; the results therefore provide convergent evidence for the importance of the insight skills specified in the intellectual processes resource. The *Stroop Color and Word Test* involved selective encoding alone and showed somewhat lower correlations with creative performance ($r = .22$, n.s. to $r = .35$, $p < .05$). For subsequent confluence analyses, an overall intellectual-process measure was created by linearly combining standardized scores for all the individual tests. The correlations of this combined measure with creative performance ranged from .50 ($p < .001$) to .61 ($p < .001$) across domains (see Table 3.2).

Table 3.1

Correlations Across Creative Performance Domains ($N = 48$)

| | Creative Performance Domain | | | |
|---|---|---|---|---|
| | Draw | Write | Advertise | Science |
| Drawing | .85 | .32* | .31* | .23 |
| Writing | | .89 | .41** | .62*** |
| Advertising | | | .81 | .44** |
| Science | | | | .87 |

* $p < .05$. ** $p < .01$. *** $p < .001$.

Note. The diagonal elements give the alpha coefficient interrater reliabilities.

Table 3.2

Correlations of Resources With Rated Creative Performance ($N = 48$)

| | Creative Performance Domain | | | | |
|---|---|---|---|---|---|
| | Draw | Write | Advertise | Science | Overall |
| Resource | | | | | |
| Intellectual Processes | .51*** | .59*** | .50*** | .61*** | .75*** |
| Knowledge | .35* | .37** | .33* | .41** | .49*** |
| Intellectual Styles | -.08 | -.28 | -.51*** | -.28 | -.39** |
| Personality | .25 | .25 | .26 | .32* | .36* |
| Motivation[a] | .28 | .34* | .61*** | .34* | .53*** |
| Combined Resources[b] | .61** | .63*** | .73*** | .66*** | .83*** |

* $p < .05$. ** $p < .01$. *** $p < .001$.

[a] Motivation is expressed as a combined score containing negative linear and negative quadratic (inverted-U) trends.

[b] Combined Resources is the regression-based multiple correlation of the five resources with creative performance.

In a separate study, described later in detail, a second sample of 44 New Haven subjects also completed the drawing and writing creativity tasks, the *Culture Fair Test of g*, the *Extended Range Vocabulary Test*, and other measures. The *Culture Fair Test of g* again correlated significantly with creative performance in drawing ($r = .35, p < .05$) and writing ($r = .36, p < .05$). These correlations were slightly lower but not significantly different ($z < 1$) from those observed in the present study. Demonstrating discriminant validity, the *Extended Range Vocabulary* test, a measure of crystallized intelligence, showed nonsignificant correlations with creative performance ($r = -.08$, n.s. for drawing; $r = .13$, n.s. for writing). Perhaps, the low correlations (-.05 to +.31) previously observed between intelligence and creativity (Barron & Harrington, 1981) were due to the use of intelligence measures that emphasized crystallized intelligence and did not fully tap relevant processing abilities (see Horn, 1976, for an alternative view). Historically, there have also been speculations that increases in intellectual ability to a certain level (IQ < 120) benefit creative performance, whereas increases in intellectual skill beyond the threshold show no consistent effect on creative performance (Golann, 1963; Meer & Stein, 1955; Schubert, 1973). Our data did not show any significant threshold or asymptotic effects for the intellectual measures employed with either of our samples (see Cohen & Cohen, 1983, for statistical methods used).

Taken together, we believe that the current results support a conceptualization of the intellectual resource for creativity that centers on insight abilities. We want to note, however, that insight processes do not necessarily form the complete set of intellectual skills for creativity. Indeed, we have recently suggested that an ability to strategically alternate between divergent and convergent modes of thinking during a project and the judicious use of evaluation to monitor one's progress on a task may be relevant high-level skills (see Sternberg & Lubart, 1993). In their recent work on creative cognition, Finke, Ward, and

Smith (1992) have proposed other sets of cognitive skills that are involved in the generation of preinventive forms and then exploration of these ideas. Generative processes include association of items in memory, synthesis and transformation of ideas, and analogical transfer. Exploratory processes include searching for useful attributes, shifting contexts when interpreting preinventive forms, and searching for limitations. Some of these processes, such as synthesis, analogical transfer, and searching for limitations overlap with those that we highlight in the investment approach. The diverse set of intellectual processes mentioned in the creative cognition approach, the investment approach, and other approaches will need to be tested more completely in future work.

**Knowledge**

Subjects reported three types of information: (a) educational level achieved; (b) perceived knowledge about drawing, writing, advertising design, and scientific problem solving; and (c) the frequency of domain-related activities. The frequency data provided a measure of familiarity for each of the task domains.

Subjects' years of education showed positive correlations of approximately .30 ($p <$ .05) for the domains of writing, advertising, and science. Self-reported knowledge level in a domain was unrelated to creative performance, with the exception was advertising knowledge, which correlated .35 ($p < .05$) with creative performance on the advertising task. In contrast to self-reported knowledge level, the frequency-familiarity measures showed some strong positive relationships to creative performance. Frequency of writing, for example, correlated .45 ($p < .01$) with writing performance. Writing frequency also correlated with advertising performance ($r = .33$, $p < .05$). This domain generality was expected because knowledge is often relevant to more than one specific task. In the scientific domain, social problem-solving frequency ($r = .51$, $p < .001$) was more important than formal scientific activity levels ($r = .08$, n.s.). Given that the scientific problems used in this study involved social rather than laboratory settings, the stronger correlation with social problem solving was reasonable.

An overall knowledge score was formed from a composite of education, knowledge level, and frequency reports. This overall score showed moderate correlations to creative performance (see Table 3.2) and is used in the analysis for a confluence of resources. Four domain-specific knowledge scores were also analyzed. The pattern of results for each domain when using domain-specific versus overall scores was very similar. We view the overall knowledge score as more useful, however, because there is relevance and value of knowledge from outside domains (e.g., writing and drawing) to a target domain (e.g., advertising).

**Intellectual Styles**

For overall creative performance, a higher level of creativity was associated with lower levels on the executive ($r = -.35$, $p < .05$), conservative ($r = -.40$, $p < .01$), and monarchic styles ($r = -.28$, $p < .10$). This correlational pattern was consistent across task domains and is theoretically meaningful; a preference for conservative, rule-following behavior is antithetical to creativity. The correlations for the liberal and local styles with creative performance were in the predicted direction but did not reach significance. The legislative ($r = -.02$, n.s.) and global styles ($r = -.35$, $p < .05$) did not relate to creative performance as predicted. For purposes of testing the role of the intellectual-styles resource in the confluence analyses, a combined score was created using executive, conservative, and monarchic styles. As expected, this combined score for the intellectual-styles resource shows negative correlations with creative performance and negative correlations with the other resources (see Tables 3.2 and 3.3).

Table 3.3

Intercorrelations of Resources ($N = 48$)

| | IP | K | IS | P | M |
|---|---|---|---|---|---|
| Intellectual Processes | — | .25 | -.44** | .22 | .57*** |
| Knowledge | | — | -.32* | .68*** | .09 |
| Intellectual Styles | | | — | -.51** | -.32* |
| Personality | | | | — | .18 |
| Motivation[a] | | | | | — |

* $p <= .05$. ** $p < .01$. *** $p < .001$.

[a] Motivation is expressed as a combined score containing negative linear and negative quadratic (inverted-U) trends.

For the *Myers-Briggs* inventory, the only significant correlation involved the sensing-intuition style. Sensing types tend to be reality oriented, to prefer rules, and to emphasize facts and precision. Intuitive types are the opposite. They concentrate on inferences, meanings, and hidden patterns. A preference for an intuitive style as opposed to the sensing style was significantly correlated with creative performance in the writing ($r = .33, p < .05$), advertising ($r = .34, p < .05$), and overall domains ($r = .39, p < .05$). This result corresponds to previous studies on the relationship of the *Myers-Briggs* inventory to creative performance (Myers & McCaulley, 1985). Furthermore, the negative role of the sensing type offers convergent evidence for the negative roles that Sternberg's executive and conservative styles displayed.

In summary, the original conceptualization of the intellectual-styles resource was partially supported. Perhaps the executive, conservative, and monarchic styles are detrimental to creativity in general while the global and legislative styles are beneficial to creativity only when the problem-finding phase of creative work is emphasized.

**Personality**

The five personality dimensions hypothesized as relevant to creativity are tolerance of ambiguity, perseverance, desire to grow, willingness to take risk, and individuality with a supporting courage of one's convictions. Based on the content of the *ACL* and *PRF* scales, relevant scores from the *Personality Research Form* and the *Adjective Check List* were standardized and then combined to form five new, reliable theory-based scales.[3] An overall personality resource measure was also formed by linear combination of the five theoretically-based scales.

[3] The theory-based personality scores were formed from standardized scores as follows: Tolerance of ambiguity = -1(*PRF* cognitive structure + *PRF* order + *ACL* order ), reliability = .91; Perseverance = (*PRF* endurance + *ACL* endurance), reliability = .85; Desire to grow = (*PRF* change + *PRF* achievement + *PRF* sentience + *PRF* understanding + *ACL* change + *ACL* achievement), reliability = .82; Willingness to take risk = -1( *PRF* harm avoidance + *ACL* self-control), reliability = .86; Individuality = (*PRF* autonomy + *PRF* dominance + *ACL* autonomy + *ACL* dominance + *ACL* self-confidence), reliability = .89. Reliability of the theory-based scales was computed following Nunnally (1967) and used established inter-item reliabilities for each of the *ACL* and *PRF* scales.

The correlations between personality dimensions and creative performance were relatively consistent across task domains. Tolerance of ambiguity correlated .19 (n.s.) with overall creative performance, willingness to take risk correlated .25 ($p < .10$), individuality correlated .26 ($p < .10$), and desire to grow correlated .39 ($p < .01$). Due, perhaps, to the short-term nature of our study, perseverance was unrelated to creativity on our tasks. In general, the influence of personality on a project probably accrues over time, leading correlations of the personality resource with creative performance during a brief task to underestimate the influence of the resource (see Abelson, 1985). The combined personality resource measure correlated .25 ($p < .10$) with drawing creativity, .25 ($p < .10$) with writing creativity, .26 ($p < .10$) with advertising creativity, .32 ($p < .05$) with scientific creativity, and .36 ($p < .05$) with overall creative performance.

**Motivation**

The self-report motivational questionnaire assessed a variety of "intrinsic" and "extrinsic" motivators in the drawing, writing, advertising, scientific, and general-life domains. The mean response on the 7-point scale for the strength of each motivator was approximately 4.0 with a standard deviation of approximately two points. Intrinsic, extrinsic, and comprehensive motivation scales for the drawing, writing, advertising, and science domains showed a pattern of significant positive correlations with the general-life scales. For the current sample, self-reported motivation in the specific domains studied does not appear to be highly differentiated from self-reported motivation for activities in general. Furthermore, the domain-specific scores did not provide independent contributions beyond the general-life motivation scores in any of the analyses to be reported. Results involving intrinsic, extrinsic, and comprehensive general-life motivation scales, therefore, are our focus.

The intrinsic, extrinsic, or comprehensive motivation scales did not show any significant linear relation to creative performance. However, as predicted, meaningful inverted-U relationships did occur; there was an optimal level for general motivation (comprehensive scale) beyond which additional motivation was negatively related to creative performance. Curvilinear trends were assessed by statistical tests following Cohen and Cohen's (1983) procedures. Hierarchical regressions showed a significant negative quadratic (inverted-U) trend for the writing, advertising, science, and overall creative performance analyses.[4] In the drawing domain, the quadratic trend was negative but nonsignificant. The incremental variance ($\Delta R^2$) explained by the quadratic motivation trend in each domain was .04 (n.s.) for drawing, .15 ($p < .01$) for writing, .40 ($p < .001$) for advertising, .11 ($p < .05$) for science, and .28 ($p < .001$) for the overall analysis.

Further supporting the investment framework's conception of the motivational resource, both intrinsic (relaxation, self-expression, gaining insights, enjoying order in a product, personal challenge, and enjoying a sense of accomplishment) and extrinsic motivation scales (earn money, desire to impress others, fulfill external expectations, and obtain a future job) showed significant inverted-U relationships to overall creativity. This result suggests that different types of motivators (intrinsic, extrinsic) are not themselves inherently good or bad for creative work. Rather, there appears to be an optimal level of motivation, beyond which a person might become too goal-focused to concentrate on the creative work itself.

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[4] Full regressions containing linear and quadratic terms were used to follow-up the hierarchical regression results (Cohen & Cohen, 1983). Across domains, the linear and quadratic components had significant negative Beta weights with approximately the same magnitude. The resultant equation ($y=-x-x^2$) produces an inverted-U function with creative performance scores (y) increasing until a moderate level of motivation (x) is reached. After this point, higher levels of motivation lead to a rapid decline in creative performance.

In terms of the confluence analyses, a combined score containing negative linear and negative quadratic (inverted-U) trends was used to represent the motivational resource (see Table 3.2); the linear and quadratic terms from the comprehensive, general-life motivation scale were standardized first and then given equal weight in the new combination score. On this new motivation-resource score, subjects with intermediate levels of motivation receive high scores and subjects with very low or very high levels of motivation receive low scores. Thus, scores on the new motivation-resource variable are expected to correlate in a positive, *linear* fashion with creative performance; the motivational resource exhibited these correlations with creative performance (see Table 3.2).

The *Creative Motivation Scale* (Torrance, in press), another measure of intrinsic motivation used in the present study, correlated .38 ($p < .01$) with the intrinsic motivation score in the general-life domain, -.06 (n.s.) with the extrinsic motivation score, and .23 (n.s.) with the comprehensive motivation score. These results offer some validation for the intrinsic items on the motivation questionnaire constructed for this study. The *Creative Motivation Scale*, however, showed no significant linear or quadratic relationships with creative performance. Examination of the *Creative Motivation Scale* suggests that several items measure personality characteristics, such as perseverance, curiosity, and willingness to grow. The heterogeneity of the item content probably affected the scale's correlations with creative performance and our own motivation measure. In general, regarding the motivation results we want to note that our findings contrast with Amabile's (1983) findings, which suggest a positive, linear relationship between intrinsic motivation and creativity. The issue of task-focused and goal-focused motivation for creativity needs to be studied further and the current findings need to replicated.

**A Developmental Trend**

An influence of the social environment may have occurred through the raters—the evaluative component of the environment. In the advertising domain, age was positively related to creative performance through 30 years, at which point the relationship turned negative. A hierarchical regression for the advertising domain showed that there was a nonsignificant linear trend, $F < 1$, and a significant quadratic trend, $F(2,45) = 3.30$, $MSe = .48$, $p < .05$, $R^2 = .13$. These trends might have been the result of generational differences in creativity standards; as the producer moves away in age from the rater, the two may increasingly differ on their standards for novelty and creativity. For example, a 65-year-old subject might have produced an advertisement that she considered creative; a 30-year-old rater might have regarded this product as out-dated. In fact, the work judged as most creative was produced by subjects who were approximately ten years younger than the average age of the raters.

The generational-differences explanation for the negative age trends in the advertising domain fits with the notion that within certain fields the type of work that is considered creative changes rapidly over time. For example, the characteristics of creative work in the literary domain may shift more slowly than the views of creative work in advertising. An alternative explanation of the inverted-U age effects through age decrements in intellectual processes ($r = -.17$, n.s.), a more conservative and executive style ($r = .14$, n.s.), less tolerance of ambiguity ($r = -.46$, $p < .001$), or less willingness to take risks ($r = -.47$, $p < .001$) seems less plausible because of the domain specificity of the age results. We are currently investigating these age effects further.

## Testing the Confluence of Resources

The investment approach predicts that high levels of creativity emerge from an interactive combination of the resources. The composite scores created for each resource were used as predictors for creative performance. Zero-order correlations of each predictor with the creativity criterion variables are presented in Table 3.2. In general, intellectual processes and then knowledge and motivation show the highest correlations. Intellectual styles and personality show some significant relationships to creative performance but there is more variability across domains.

The intercorrelations of the resource variables ranged in absolute value from .09 (n.s.) to .68 ($p < .001$) (see Table 3.3). All the correlations between resources were positive except for correlations with the intellectual-styles resource, which, as explained above, were negative. The intercorrelations support the idea of a "creativity syndrome"—the determinants of creativity seem to co-occur to a moderate extent (see Mumford & Gustafson, 1988).

Multiple regressions of creative performance on the five measured resources provide evidence that the resources, although related, make some independent (unique) contributions to creative performance. Forward-selection, backward-selection, and full regression procedures all lead to virtually identical results; the results for the full regression procedure are discussed.

In the drawing domain model, only the intellectual processes resource accounted for a significant portion of unique variability ($\beta = .55, p < .01$), ($F(5,42) = 4.96, MSe = .36, p < .01, R^2 = .37$). For the writing domain, intellectual processes again bore a strong relationship to performance ($\beta = .53, p < .01$). Knowledge showed a weight of .36 ($p < .05$). We also found a significant linear interaction of intellectual processes and knowledge for the writing domain ($\beta = .29, p < .05$). This interaction showed that a high level of both resources was especially beneficial. Inclusion of the interaction term increased the writing variance explained from .40 for 5 resource equation to .48, ($F(6,41) = 6.33, MSe = .39, p < .001$).

The results for the advertising domain suggest that the resources may receive domain-specific emphases. The resources with significant weights in the advertising model were motivation ($\beta = .49, p < .001$), intellectual styles ($\beta = -.35, p < .05$), and knowledge ($\beta = .32, p < .05$), ($F(5, 42) = 9.72, MSe = .27, p < .001, R^2 = .53$). The negative beta weight for intellectual styles indicates that as the proclivity toward executive, conservative, and monarchic styles increased, creative performance decreased.

The science domain results and overall (multiple domain) performance analyses return us to the relevance of the intellectual processes resource in terms of unique predictors. For science, the intellectual resource had a significant regression weight ($\beta = .56, p < .001$) and the knowledge resource parameter ($\beta = .24$) was marginal, $F(5,42) = 6.69, MSe = .33, p < .001, R^2 = .44$). For overall performance, intellectual processes ($\beta = .57, p < .001$) and knowledge ($\beta = .36$, p <.001) were significant and motivation showed a marginally significant parameter ($\beta = .19, p < .10$), ($F(5,42) = 18.41, MSe = .11, p < .001, R^2 = .69$). In closing this section on the confluence results, we note that all of the regression results should be viewed as tentative and remain to be replicated.

## Study 2: Cognitive Risk-Taking and Creative Performance

We conducted a second study to focus on the notion of "buying low" and taking risks for creative performance. The financial market illustrates the "rules" of risk-taking in a monetary domain. Investment in a long-standing company with a record of slow growth involves less risk than investment in a new company that promises fast growth. The new company is unproven, and while the opportunity for larger profits exists, there is also increased uncertainty that the profit will materialize. Investors may choose to "buy low" and risk their money on the unproven company, hoping for the big payoff or to "buy high," choose an established firm, and be relatively sure of small profits.

Analogous to the financial world, most endeavors offer more and less risky alternatives; in any domain, "buying low" involves taking risks. For creative work, the risks tend to be intellectual ones (which carry social and monetary ramifications). An artist, for example, may choose between several projects. Within each project, there may be further options for topics, topic development, materials, and style. Typically, the choices at each step fall into two risk-payoff options. One option can be labeled "low risk-low payoff" because a high probability of success is usually associated with following a well-worn problem-solving path. The other option, "high risk-high payoff," offers a chance of great success but the path is treacherous and less traveled.

Willingness to take risk, a personality trait, guides the problem-solving route that a person will pursue. Risk-taking influences whether cognitive abilities, such as insight processes, will be applicable during problem solving or unnecessary because a routine path is being pursued. Thus risk-taking can be viewed as one of the keys to creative performance because risk-taking opens opportunities for creativity-relevant cognitive resources to be utilized.

In a variety of contexts (general decision-making, business, and school), studies show that people tend to avoid risks, preferring the low risk-low payoff option (Clifford, 1988; Dreman, 1977; Kahneman & Tversky, 1982; MacCrimmon & Wehrung, 1985). People follow the proverb: A bird in hand is worth two in the bush. The investment approach suggests that this general aversion to risk partially accounts for the infrequency of creative performance. Although "buying low" and taking risk does not guarantee that creative performance will occur, "buying high" basically guarantees that it will not.

Two studies offer preliminary support of the risk-taking—creative performance link that we have been developing. Eisenman (1987) presented 200 adult subjects with a contest situation and found that selection of the high risk-high payoff option was related to high performance both on a measure of creative attitudes and on a divergent thinking test ($r = .34$ to $r = .37$, $p < .01$). Glover (1977) induced risk-taking in college students through group discussions of risky decision-making situations. Compared with control subjects, the risk-induced subjects showed higher originality and flexibility scores on the *Torrance Tests of Creative Thinking* ($p < .01$). Our study builds on this work and uses multiple assessments of risk-payoff preferences and multiple domains of creative performance.

### Method

Forty-four subjects from the New Haven area (22 males, 22 females) with an average age of 32.37 years ($SD = 13.13$, range: 18-67) completed four kinds of tasks. The measures were (a) creativity tasks, (b) cognitive tests of intellectual ability, (c) risk-taking contests, and (d) self-report measures of risk-taking, personality, and biographical information.

For creativity measures, drawing and writing tasks from our first study, described earlier, were used. The cognitive tests consisted of the *Cattell Culture Fair Test of g*, Scale 3, Form A (Cattell & Cattell, 1963), for fluid intelligence and the *Extended Range Vocabulary Test*, Scale V-3 (French, Ekstrom, & Price, 1963) for crystallized intelligence.

Two contests provided behavioral measures of risk-taking. Subjects were given the opportunity to enter their drawing in one contest and their short story in another contest. Each contest established two "pools" of work from which the best entries would be selected. One pool was described as high risk and high payoff. In this pool, there was one winner of $25. The other pool involved lower risk and lower payoff, with five winners of $10 each. The instructions allowed subjects to enter one pool for the drawing contest and a different pool for the writing contest, if they desired. Based on our judges' ratings, prizes were awarded at the conclusion of the study.

The self-report questionnaires measured propensity toward risk-taking in a very different way. Three choice-dilemma questionnaires assessed risk-taking in the drawing, writing, and general-life domains. The general-life questionnaire was an updated version of Kogan and Wallach's (1964) original instrument; gender-specific language and some factual details were revised. The drawing and writing questionnaires were constructed for this study as domain-specific forms of Kogan and Wallach's questionnaire.

Each questionnaire contained twelve hypothetical situations. Subjects were asked to imagine themselves in the situations. Each scenario presented a choice between two courses of action: (a) a high risk, potentially high-payoff alternative, and (b) a low risk, low-payoff alternative. Subjects selected the minimum odds of success that they would require before pursuing the high-risk option. A sample scenario from the drawing-domain questionnaire follows:

> You are a potter, making a large vase to be displayed at a pottery craft show. You hope to receive recognition in the pottery guild's magazine that will be doing a feature story on the show. You have two ideas for a vase. Idea A would use a potter's wheel to form a vase with smooth contours that are pleasing to look at. You know that several other potters at the show use the same method but you feel confident that you will receive a little recognition for technical skill in your vase. Idea B would use a hand coil method in which you roll clay into strips and piece the strips together. This method yields an unusual primitive vase. The magazine editors may feature your coil vase because of its uniqueness or they may not even mention it because it could be seen as too far out of the mainstream. Listed below are several probabilities or odds that the coil vase (idea B) will turn out successfully. Please check the lowest probability that you would consider acceptable to make it worthwhile to pursue the coil vase.

The possible odds for success were: 1 in 10, 3 in 10, 5 in 10, 7 in 10, or 9 in 10. A subject could also refuse the risky alternative "no matter what the probabilities" and then would receive a score of 10 out of 10 for that scenario. The questionnaire reliabilities were adequate (.74 to .78). The scores are reflected (multiplied by -1) to maintain consistency with other risk measures. High (reflected) scores on these choice-dilemma questionnaires therefore indicate risk-taking.

Risk-taking was further assessed with items on the biographical questionnaire. Subjects used a 7-point scale to describe their risk tendencies in drawing and writing for the overall task, topic selection, topic development, and materials and style used. Subjects were also asked if they would describe themselves as a high or low risk-taker in the drawing and writing domains.

Another portion of the biographical questionnaire provided a brief assessment of educational history, knowledge-level, activities and interests in the domains studied, and personality-motivational tendencies. The *Adjective Check List* (Gough & Heilbrun, 1983) also measured personality characteristics. On the final portion of the biographical questionnaire, subjects judged the creativity of their own products using 7-point response scales.

Subjects were tested individually during a three-hour session. The drawing and writing tasks were administered first, followed by the choice-dilemma questionnaires, the Adjective Check List, biographical questionnaire, *Cattell Culture Fair Test of g*, and *Extended Range Vocabulary Test*. Subjects chose a contest group in which to enter their work either at the start of the session before they worked on the creativity tasks or at the very end, after finishing the creativity tasks. We therefore manipulated the timing of the contest decision.

A separate group of 15 New Haven subjects (8 males, 7 females; *m* age = 31.73, *SD* = 6.83, range: 22-45) judged the creativity of the drawing and writing work with good interrater reliability.

## Results and Discussion

### Aspects of Cognitive Risk-Taking

In accord with previous research, people were relatively risk-avoidant. In the drawing contest, 32 of the subjects chose the low risk-low payoff option, in contrast to 12 who chose the high risk-high payoff alternative. In the writing contest, 29 subjects selected the low risk and 15 selected the high risk. In both cases, the bias toward lower risk was significant ($p < .05$). On the hypothetical scenario measures, subjects were slightly risk averse. For each questionnaire where low scores (-120) indicate risk aversion, the mean scores were -64.14 (*SD* = 19.85) for drawing scenarios, -60.61 (*SD* = 19.14) for writing scenarios, and -71.77 (*SD* = 19.19) for general-life scenarios. Subjects also described themselves as somewhat risk-averse on the self-report items. On a 7-point scale with low scores indicating risk aversion, the mean response was 3.06 (*SD* = 1.77) for the drawing domain and 3.64 (*SD* = 1.78) for the writing domain.

The tests of intelligence as well as years of education were essentially unrelated to risk-taking. However, self-reported levels of knowledge for drawing and writing correlated with self-reported risk taking in the respective domains (drawing: $r = .48, p < .01$; writing: $r = .33, p < .05$). Similarly, the frequency with which a subject engaged in drawing or writing activities and liked these activities correlated moderately with domain-specific risk-taking on contest, hypothetical scenario, and self-report measures (median $r = .31, p < .05$). Scores on the self-confidence, desire for change, and the creative personality scales from the *Adjective Check List* were moderately related to risk-taking on the hypothetical scenario measures.

As mentioned in the procedure section, we varied whether subjects had to choose their contest option (high or low risk) before beginning their drawings and short stories or after finishing them. The manipulation had no measurable effect on the level of risk-taking or the relationship between risk-taking and creative performance. This null finding suggests that risk-taking does not depend especially on the producer looking at the final product and judging whether it is good enough to enter into a high-risk contest. We suggest that risk-taking is a personality trait that develops and is influenced by prior experiences in a domain. Early, successful experiences increase self confidence and the tendency for risk-taking. The results, described below, that link creative performance with risk-taking in hypothetical scenarios (different from our creative performance tasks) further support the idea that risk-

taking is not simply a pragmatic choice once a product has been completed, but rather a pervasive tendency that can influence each step of problem solving.

**Risk-Taking and Creative Performance**

The main question of interest is whether higher levels of risk-taking are associated with higher levels of creative performance. For the drawing contest, subjects choosing the high risk-high payoff option showed a mean creativity score of 4.21 ($SD$ = .99) whereas subjects choosing the low risk-low payoff option showed a mean score of 3.90 ($SD$ = .75). Although this result did not reach significance, a follow-up analysis using creativity ratings from three graduate-student judges with artistic background showed stronger results. The high-risk group received a mean creativity score of 4.36 ($SD$ = 1.98) and the low risk group's mean score was 2.86 ($SD$ = 1.57), $t(42) = 2.62$, $p < .05$. The "artistic" judges also showed high reliability ($alpha$ = .83).

The scenario-based measures of risk-taking supported a connection between risk-taking and creativity. Risk-taking on the drawing scenarios correlated significantly with drawing creativity ($r = .39$, $p < .01$). A multiple regression of the drawing, writing, and general-life scenario scores on creative performance in the drawing task tested for domain specificity between risk-taking and creativity, ($F(3,40) = 3.91$, $MSe = .56$, $p < .05$, $R^2 = .23$). The drawing scenario measure was the best predictor ($\beta = .54$, $p < .05$). The general-life scenario measure acted as a suppressor effect, enhancing the domain specific nature of the drawing risk measure ($\beta = -.38$, $p < .06$). Further supporting domain specificity, the writing scenario measure showed a non-significant weight in the equation.

In contrast to the situational scenario and behavioral contest measures of risk, self-report items showed little relationship to creative performance. Only one item that assessed "overall" risk-taking on drawings related to creative performance ($r = .34$, $p < .05$).

In summary, we found some support for the hypothesized link between risk-taking and creative performance in the drawing domain. The drawing scenario measure of risk-taking showed this relationship most clearly. In the writing domain no significant results were obtained. However, examination of the writings produced by subjects who scored in the top 20 percent and bottom 20 percent on the writing risk scenario measure suggested an interesting trend: We believed the stories of the high risk-takers to be more unconventional than those of the low risk-takers. We had three additional peer judges rate unconventionality and found a significant difference in the ratings for high risk-takers ($m$ = 4.00, $SD$ = .75) versus low-risk takers ($m$ = 3.11, $SD$ = .85), $t(16) = 2.36$, $p < .05$.

An investigation of the stories suggests that the unconventional stories did not receive high creativity ratings, on average, because of the controversial issues with which the stories dealt. For example, one high-risk-taking subject chose "It's moving backward" as a title and offered a negative view of American politics. In this case, as well as others, the risk did not pay off with respect to the judges. Perhaps our judges had a narrower view of what constitutes a creative short story compared to a creative drawing, so the range of risk-taking that could lead to an acceptable product was limited.

## Conclusions

The current results provide initial support for the investment approach but also suggest revisions and areas for further research. The basic conceptualization of the intellectual processes, knowledge, and personality resource were supported by the results;

these results also support and extend earlier theoretical and empirical work (e.g. Amabile, 1983; MacKinnon, 1962, 1965; McClelland, 1956). The intellectual styles resource did not operate completely as expected. Executive, conservative, and monarchic styles were negatively related to creative performance but the legislative and global styles did not promote creative work. These findings may be due to the semi-structured nature of our creativity assessments. In any case, the intellectual styles resource requires further study and possible revision. Finally, the motivational resource showed an inverted-U relationship to creative performance, which is consistent with our task-focused versus goal-focused distinction.

In terms of the relative importance and confluence of resources, several promising results were also obtained. First, creative performance was most related to the intellectual processes resource. This result is sensible because the creative performance measures involved short-term, timed tasks. We noted earlier that certain resources such as personality may show their importance in long-term projects rather than short-term tasks. Second, regression analyses showed significant involvements for multiple resources. For example, the analysis of overall creative performance showed that intellectual processes, knowledge, and motivation accounted for unique portions of variance. Third, the creative performance measures and the confluence analyses addressed the issue of domain specificity. For example, the motivation and intellectual styles resources received emphasis in the advertising domain. And, an interaction between intellectual processes and knowledge was observed as specific to the writing domain. Together, these results demonstrate the utility of a multivariate approach to creative performance.

At a general level, the results are congruent with many recent proposals that suggest the need for a convergence of cognitive and conative elements for creativity (see Amabile, 1983; Arieti, 1976; Barron, 1988; Csikszentmihalyi, 1988; Feldman, 1988; Gardner, 1988; Gruber, 1981; Mumford & Gustafson, 1988; Simonton, 1988). For example, Amabile (1983) describes creativity as a result of domain-relevant skills (knowledge and abilities), creativity-relevant skills (styles, personality traits, and idea-generation heuristics), and motivation (primarily intrinsic motivation). High levels of these components must co-occur in an appropriate environment to yield high levels of creative performance. Portions of the current results can be seen as supportive of both Amabile's model and the investment approach.

At this time a rigorous test between various confluence theories of creativity is not possible for two reasons. First, confluence theories need to become more specific than they are at present. We acknowledge that the investment approach must move toward greater specificity. The current results suggest that domain and task variables are important for determining the nature of a resource confluence for creativity. Second, studies need to test both competing theories' concepts of the resources for creativity and these theories' concepts of the confluence of resources. It is possible that empirical support for a specific resource confluence will depend on the specification of the resources involved.

Next, we can consider the investment concept of "buying low and selling high." The results of the study on cognitive risk-taking provide some support for the benefits of "buying low," but we want to note that the test of the investment metaphor was limited. In general, the investment approach is part of an emerging economic perspective on creativity. Contributing to this perspective, for example, Rubenson and Runco (1992) propose an account of societal levels of creativity using the concepts of supply and demand. They apply cost-benefit analysis to people's decisions to actively seek creativity training. Also, Walberg (1988) has emphasized society's need to develop "human capital," the "knowledge, skills, and talents" necessary for creative work.

The investment approach and the new economic perspective on creativity offer many avenues for research. The investment approach, specifically, still remains to be tested (a) over longer periods of time using significant work produced prior to the investigation, (b) using more eminent samples, and (c) using samples with broader distributions on the resources to better test the confluence hypotheses. Also, the measurement of the resources needs to be improved, the direct effects of the environment need to be assessed, and the relationship between risk-taking and creative performance needs to be studied more completely.

Finally, the investment approach and the creative-cognition approach can benefit by drawing connections between each other. For example, creative-cognition research has attempted to analyze problem tasks and specify the particular generative processes, preinventive structures, and exploratory processes that are employed in each task. The investment approach needs to move toward this type of specific modeling. Also, the investment approach needs to be linked to a process model of creative problem solving. This process model may be a general one that covers problem solving in a wide range of domains, such as the generation-exploration model of Finke, Ward, and Smith (1992). Alternatively, domain-specific process models may be necessary. Within each task's process model, we would want to specify the points where various intellectual processes are most active, when and how knowledge is utilized, and whether intellectual styles, personality, motivation, or environmental resources influence specific portions of the process or act in general ways. For example, insight processes and tolerance of ambiguity may be especially important during the initial conception of a project whereas solution monitoring and perseverance may be most important in the later stages of a project.

Our work with the investment approach also suggests new directions for creative cognition research. First, work on creative cognition may consider how a general strategy, such as attempting to buy low and sell high, could pervade creative work and influence actions at each problem-solving step. Second, creative cognition research may consider the impact of non-cognitive (personality, motivational, and environmental variables) on the effectiveness and use of cognitive processes. Third, creative cognition research may investigate whether beneficial interactions occur when certain generative processes are used together with particular exploratory processes or preinventive structures.

In conclusion, the results provide initial support for many aspects of the investment approach's person-centered resources for creativity—intellectual processes, knowledge, intellectual styles, personality, and motivation. The results also demonstrate the relative importance of cognitive resources, show beneficial effects from a partial confluence of the person-centered resources, and show a partial link between buying low and creative performance. We suggest that the investment approach offers a framework with which previous work can be integrated and the current results can be understood. The investment approach also offers a base from which future links can be developed to other multivariate approaches, other economic-based approaches, and work in the creative-cognition approach.

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# PART 4: What Do We Mean by "Giftedness"? A Pentagonal Implicit Theory

Why is a child who scores in the top 1% on the *Wechsler Intelligence Scale for Children* much more likely to be labeled as "gifted" than a child whose 100-meter sprinting time places her in the top 1% of her age cohort? Why is a physicist who is considered Number 1 in the country by his peers or another panel of judges considered gifted, whereas the criminal who is Number 1 on the FBI's most-wanted list is not? Why do contestants in major beauty contests, such as the Miss America Pageant have to answer questions about issues perceived to be of domestic or international importance, whereas contestants in the major scientific competitions, such as the Westinghouse Science Talent Search, do not have to submit to judgments of their personal attractiveness? The pentagonal implicit theory of giftedness (Sternberg, 1993), described herein, seeks to answer these and related questions.

## The Nature of Implicit Theories

Implicit theories are not public or formal. Rather, they are intellectual constructions that reside in individual people's minds (Sternberg, 1985b; Sternberg, Conway, Ketron, & Bernstein, 1981). Such theories can be discovered through questions and inference, and are often revealed by behavior. Typically, however, we do not examine our implicit theories closely until questioned; we simply employ them in making our everyday judgments of the world and of those who inhabit it. For example, we each have an implicit theory of what constitutes charisma, and when we meet other people, we judge them against the standards of this unspoken construct. Similarly, we each have an implicit theory of what constitutes giftedness.

Contrasting with implicit theories are explicit theories, the constructions of psychologists or other scientists that are based or at least tested, in psychology, on data collected from people performing tasks presumed to measure psychological functioning. Explicit theories have dominated the literature on giftedness (see, for example, Sternberg & Davidson, 1986, for a collection of such theories). Theorists specify what they believe to be the elements of giftedness, and then try to verify that their claims are psychologically or educationally valid.

Why even bother to study implicit theories of giftedness? What difference does it make what a layperson thinks when there are well-informed theorists who have devoted their professional lives to studying and judging the problem? There are at least five reasons why it is worthwhile to understand people's conceptions (implicit theories) of giftedness.

First, discovering such implicit theories can be useful in helping to formulate the common-cultural views that dominate thinking within a society—what we mean, for example, by "giftedness." Second, understanding implicit theories can also help us understand or provide bases for explicit theories, because explicit theories derive in part from scientists' or other researchers' implicit theories of the construct under investigation. In other words, explicit theories are themselves the result of implicit ones. Third, implicit, not explicit, theories have the most influence on actual everyday life and practices. People's generalized implicit theories of giftedness, for example, determine how decisions about identification are made. Fourth, if we want to "change our ways"—to improve our criteria for identifying the gifted—we need to know exactly what those ways are. Fifth, and perhaps most importantly, one might argue that in the case of giftedness, implicit theories have a privileged status that they do not have in the case of other constructs, such as

memory. Why? Because in the case of memory, there is good evidence that the construct is based on an actual set of related biological phenomena, many of which probably take place in the hippocampus. In the case of giftedness, however, we seem to be dealing, at least in part, with a labeling phenomenon. Consider why.

In one culture, the gifted individual might be a hunter, in another, a gatherer, and in a third, a student. The first two cultures might not even have any form of formal schooling. Giftedness, like beauty, seems to exist in the eyes of the beholder; memory does not. Just as cultural standards for beauty may vary (Duck, 1991), so may cultural standards for giftedness. This is not to say that, within a culture, no objective criteria for giftedness can be defined. But the criteria are determined by one's external culture, rather than by one's internal physiology.

In sum, implicit theories of giftedness are important, for they provide a dimension of understanding that cannot be obtained through the study of explicit theories. This does not mean that explicit theories are unimportant. Rather, both kinds of theories are needed, and should be studied in conjunction. Implicit theories provide the form or structure by which we define giftedness, whereas explicit theories provide the content that is embedded within that form or structure.

## The Pentagonal Implicit Theory of Giftedness

The goal of the pentagonal implicit theory of giftedness is to capture and systematize people's intuitions about what makes an individual gifted. It is important to state that, in general, implicit theories need not be "correct," in any ultimate sense. Once upon a time, almost everyone instinctively believed that the sun revolved around the earth. Their implicit theory was wrong. To the extent that giftedness is like beauty, however, there is no right and wrong, but only what people perceive to be better and worse, or higher and lower on some scale. The theory states that in order to be judged as gifted, a person needs to meet five criteria: (1) the excellence criterion, (2) the rarity criterion, (3) the productivity criterion, (4) the demonstrability criterion, and (5) the value criterion.

1. **The Excellence Criterion.** The excellence criterion states that the individual is *superior in some dimension or set of dimensions relative to peers.*

To be gifted, one has to be extremely good at something—in psychological terminology, high in a judged dimension or dimensions. The qualification "relative to peers" is necessary because the designation of excellence depends upon the skills of those against whom one is judged. A 10-year-old's raw score on an intelligence test might convert into a very high score relative to age peers, but would seem unexceptional relative to children five years older. Similarly, a musical performance that would be exceptional for an 8-year-old taking weekly music lessons at school might be quite undistinguished for an 8-year-old who has been trained at a conservatory since age four.

2. **The Rarity Criterion.** The rarity criterion states that in order to be labeled as gifted, an individual must possess a *high level of an attribute that is rare relative to peers.*

The rarity criterion is needed to supplement the excellence criterion because a person may show an abundance of a given attribute, but if a high evaluation of that attribute is not judged to be rare, the person is not viewed as gifted. Suppose we give a test of mastery of the basics of the English language to a class of college seniors at a good university. They should all make high scores on the test, because all are fully proficient in

the basics of English. But even if all received perfect scores, we would not say they are all therefore gifted. Thus, one may display excellence, but unless such excellence is rare, that person is not likely to be viewed as gifted.

3. **The Productivity Criterion.** The productivity criterion states that *the dimension(s) along which the individual is evaluated as superior must lead to or potentially lead to productivity.*

Consider again the contestants in the beauty contest. Why is it that they must answer questions about issues of the day, rather than merely being judged solely on their appearance? Appearance is probably the major determinant in the contest, so why is it not sufficient? Despite the fact that the contest is really about beauty, beauty in itself is not perceived as productive or potentially productive. The contestant needs to demonstrate that she can *do* something beyond just looking good. In contrast, the contestant in a scientific competition is not judged on other dimensions such as personal appearance, because the scientific work itself—the basis of the contest—is viewed as productive.

The productivity criterion generates disagreements over exactly who should be labeled as gifted. Some, for example, believe that a high score on an intelligence test is not sufficient grounds for labeling a person as gifted; the high-scoring person hasn't shown that he or she can "do" anything (e.g., Gardner, 1983). To others, getting a high score on the test is viewed as doing something in and of itself; at worst, it shows the person's potential for productivity.

In childhood, of course, it is possible to be labeled as gifted without having been productive. In fact, children are typically judged more on potential than on actual productivity. As people get older, however, the relative weights of potential and actualized potential change, with more emphasis placed on actual productivity. People who do not realize their potential through some kind of productive work may still be labeled as gifted, but with qualifications. To earn the label "gifted" without qualification, a person must accomplish something.

4. **The Demonstrability Criterion.** The demonstrability criterion states that the *superiority of the individual on the dimension(s) which determine "giftedness" must be demonstrable through one or more tests that are valid assessments.*

The individual needs to be able to demonstrate, in one way or another, that he or she really has the abilities or achievements which led to the judgment of "giftedness." Simply claiming giftedness is not enough. Thus, a person who scores poorly on all measures used in assessment, and who is unable to demonstrate in any compelling alternative way that he does indeed have special abilities, will not be viewed as gifted.

The assessment instrument(s) used, however, must be valid. Validity means that each instrument is believed to measure what it is supposed to measure. If, for example, a child presents a high score on a new intelligence test that requires only that the child dot i's, the result will not be valid. Dotting i's is not an acceptable measure of intelligence. Or suppose that a job candidate gives a brilliant talk, suggesting unusual gifts both in research and in presentation. But then, when asked about the content of the talk, he is unable to answer even the simplest of questions. Members of the audience gradually conclude that the candidate was somehow "programmed," probably by his advisor. The job talk would then be invalid as a measure of the candidate, because it did not actually reflect his gifts (or lack thereof).

The validity issue has become extremely important in recent years in the identification of intellectually gifted schoolchildren. In the past, many schools were content to use standardized intelligence tests, and perhaps grades in school and scores on achievement tests, as bases for identifying children as intellectually gifted. As the focus of testing has been shifting more and more toward an emphasis on performance- and product-based assessment, however, some have questioned the validity of the traditional measures (e.g., Gardner, 1983; Renzulli, 1986). Someone who would have been labeled as gifted under traditional measures before might not now be so labeled. The implicit theory of giftedness may not have changed, but what is considered valid as a demonstration of giftedness may have.

5. **The Value Criterion.** The value criterion states that for a person to be labeled as gifted, *the person must show superior performance in a dimension that is valued for that person by his or her society.*

The value criterion restricts the label of giftedness to those who hold attributes that are valued as relevant to giftedness. The individual who is Number 1 on the FBI's most wanted list might be superior in one or more dimensions, rare in his ability to perform certain malevolent acts, and able to demonstrate his skills upon demand. He may even be highly productive—in a criminal way. But because what he is so good at is not valued by society at large, he is not likely to be labeled as gifted by the American populace. Still, it is quite possible that he would be labeled as gifted by a pack of thieves; the pentagonal theory allows that what is prized as a basis for giftedness may differ from one culture or even subculture to another.

Implicit theories by nature are relativistic; there is never any guarantee that people's personal values will match across time and space. But implicit theories, as noted above, provide the best practical form or structure by which to identify the gifted. For a judgment to occur according to strict standards, one needs to add content to implicit theories. This is the role of explicit theories, considered next.

## The Role of Explicit Theories

Implicit theories are necessarily relativistic, because what is perceived is often time- and culture-dependent. Consider, for example, intelligence. We know from studies of implicit theories that what people consider to be intelligent differs across time and place (Berry, 1984; Serpell, 1974; Wober, 1974).

On the other hand, explicit theories of intelligence attempt to specify just what intelligence is, so that whether a given person is *actually* intelligent (according to a given explicit theory) will depend upon the person's standing as measured by that theory. Note the importance of the qualifier, "according to a given explicit theory." The judgment made is still relative to an explicit theory, and as we know, such theories differ.

Consider, for example, two contemporary theories of intelligence, those of Gardner (1983) and of Sternberg (1985a). According to Gardner, a person of extraordinarily high musical ability is *intellectually* gifted by virtue of the superiority of the *musical* ability. According to Sternberg, such a person is musically gifted; the person is *not* intellectually gifted by virtue of the superior musical ability, although that individual might well be intellectually gifted based on further information.

In short, explicit theories provide definitions of content. But we are still left with the judgments that the explicit theory is derived from. The problem is that in the science of understanding human gifts, we do not yet have certainties. There are no explicit theories now known to be totally and absolutely correct, nor is that very likely in the foreseeable future. Nevertheless, the combination of implicit and explicit theories can help us understand both the structure people instinctively use for labeling others as gifted, and the more objective content (or specific scales) they use to give force to these labels.

## Data

Does the pentagonal implicit theory actually capture people's intuitions about giftedness? Do people really use these criteria in making their evaluations of others? We decided to find out.

## Method

In the spring of 1992, we tested two groups of subjects: 24 students—12 male and 12 female—at Yale University, and 39 parents of gifted children in Connecticut. Roughly half of each gender group evaluated boys; the other half girls. We gave each subject 60 brief descriptions of imaginary students. Each description included the following items:

1. How the student scored nationally on a given standardized test. (Described as "good, mediocre, excellent," etc.)
2. How this score ranked within the student's school. (Top 20%, etc.)
3. How accurate the school feels the given test is in predicting gifted performance.
4. How much value the school places on a given test as a measure of giftedness.
5. The number of independent projects (prescreened for high quality) a student submitted.
6. How much value the school places on independent projects as a measure of giftedness.

The subjects them made two evaluations. On a scale of 1-6 we asked them to rank

1. **How likely** they thought **the school** would identify this child as gifted and
2. **How likely** they thought **they personally** would identify this child as gifted.

The experiment was designed to allow use of multiple regressions to predict ratings of likelihood of students being identified as gifted (the dependent variable) from the six independent variables in each description. The six independent variables, based on the pentagonal implicit theory, were:

| | |
|---|---|
| (1) excellence | (Statement 1) |
| (2) rarity | (Statement 2) |
| (3) productivity | (Statement 5) |
| (4) demonstrability (i.e., validity) | (Statement 3) |
| (5) value | (Statements 4, 6) |

Thus, a significant regression weight for any criterion would indicate its use in judgments of giftedness.

## Results

Overall mean ratings on the 6-point scale for the 24 student subjects were 4.26 for girls—school rating, 4.13 for girls—self rating, 4.15 for boys—school rating, and 4.07 for boys—self rating. Mean ratings of boys and girls did not differ significantly. For the 39 parent subjects, comparable means were 3.99, 4.18, 3.85, and 4.08 respectively. Of greater interest here, though, are the results of the multiple regressions, which are summarized in Tables 4.1 and 4.2. The results are practically identical for the two samples.

Excellence, rarity, productivity, and value of the test showed statistically significant regression weights in all four multiple regressions. The weight values for the independent projects was statistically significant in all but one regression. Patterns of weights were similar for evaluations of boys and of girls. Interestingly, our subjects believed that *they* would take validity (demonstrability) into account in their evaluations, but that the *school* would not. Subjects also believed that they took excellence into account more than would the school, whereas the school's system of values was clearly seen as more important to the school than it was to the subjects doing the ratings.

Overall levels of prediction were quite high, with $R^2$ values varying from .68 (corresponding to a multiple correlation of .82) to .91 (corresponding to a multiple correlation of .95). These levels were somewhat higher for the self ratings than for the school ratings, which makes sense, as subjects are more likely to believe they know their own implicit theory than that they know the implicit theory of the school.

These results are generally consistent with the pentagonal implicit theory. They suggest that people take into account the five points of the theory in making evaluations, and believe that the school takes into account all of the points except instrument validity (demonstrability). Of course, our population of subjects was a limited one, and we plan to do subsequent research with other populations.

Table 4.1

Summary of Multiple Regression Analyses: Student Sample

| | $\beta$ (standardized regression coefficient) | | | |
|---|---|---|---|---|
| Rating (statement) | Girls-School | Girls-Self | Boys-School | Boys-Self |
| Excellence (1) | .32*** | .73*** | .28*** | .55*** |
| Rarity (2) | .45*** | .38*** | .25** | .23*** |
| Productivity (5) | .37*** | .22*** | .44*** | .58*** |
| Demonstrability (3) | .00 | .13** | .03 | .28*** |
| Value (4) | .49*** | .26*** | .50*** | .19*** |
| Value (6) | .26*** | .10* | .28*** | .07 |
| $R^2$ | .78*** | .91*** | .68*** | .87*** |
| Root-mean-square error | .46 | .33 | .60 | .38 |

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4.2

Summary of Multiple Regression Analyses: Parent Sample

| Rating (statement) | $\beta$ (standardized regression coefficient) Girls-School | Girls-Self | Boys-School | Boys-Self |
|---|---|---|---|---|
| Excellence (1) | .33*** | .53*** | .34*** | .49*** |
| Rarity (2) | .29*** | .35*** | .24** | .37*** |
| Productivity (5) | .34*** | .50*** | .44*** | .67*** |
| Demonstrability (3) | .02 | .25*** | .00 | .11** |
| Value (4) | .50*** | .28*** | .43*** | .18*** |
| Value (6) | .44*** | .20*** | .35*** | .13** |
| $R^2$ | .76*** | .90*** | .68*** | .91*** |
| Root-mean-square error | .49 | .24 | .66 | .26 |

* $p < .05$. ** $p < .01$. *** $p < .001$.

($N = 39$ Parents evaluating 21 girls and 18 boys)

## Implications for Educational Practice

Consider now how the pentagonal theory, in combination with explicit theories, helps us address the standard questions of identification and instruction that arise about gifted education. The pentagonal theory does not directly answer these questions, but rather suggests the directions answers might take. Those who wish to use the pentagonal implicit theory in conjunction with particular explicit theories are encouraged to do so, though recommendations for precisely which approaches to take are not the goal of this monograph. A wide array of explicit theories about giftedness exists, from Gardner's (1983) theory of multiple intelligences to Sternberg's (1985a) triarchic theory, and from Stanley's (1976) acceleration model to Renzulli's (1977) enrichment model. Some of these, and others, are discussed further in Sternberg and Davidson (1986).

1. **What percentage of children should be identified as gifted?** This question is often asked as though there is a "right" answer. Of course there isn't. But the pentagonal theory helps us address this question by separating two often-confounded concepts that ought to be distinguished: excellence and rarity.

Our use of norm-based measurement, which practically equates the two, leads us into confusion. All of us who have taught know that in one year we may have an "excellent" class, in which many or even most of the students perform at a very high level, whereas in another year we may have a weak class, in which few people perform well. Criterion-based measurement helps us escape the confounding of excellence with rarity.

One way of using the pentagonal theory is to suggest that we identify as gifted that percentage of students whose performance on some set of standards meets a preset criterion

of excellence, and for whom we have the resources to provide special services. We will thereby acknowledge that our limitations in identification reflect not only students' abilities, but our own ability to serve such students.

We need to consider excellence independently of rarity, and to realize that we seek out rarity in part because of our inability to serve all students who may truly have very impressive potentials.

2. **What constructs or measures should we use to identify the gifted?** The pentagonal theory makes clear that there is no one "right" construct measure, or even set of constructs or measures, that we "ought" to use. Rather than simply doing what we do because it has always been done that way, we need to take responsibility for stating explicitly just what it is that we value and why. If we care about the potential of an individual to contribute to himself, others, and society in a productive way, then we need to justify why the measures we use will help identify such potentially productive individuals.

The least "metacognitively aware" formulators of programs for the gifted simply use whatever measures have been used in the past to identify the gifted in a way that is almost wholly lacking in reflection and self-awareness. Call them "Stage I" programmers. Stage II programmers, somewhat more aware of thinking theories and processes, will latch onto a particular explicit theory of giftedness and use that, citing the theorist as their authority. At least such programmers have considered some alternatives. Stage III programmers are still more metacognitively aware, and will be able to defend why they use So and So's theory, or even traditional techniques not clearly based in any theory. But the most thoughtful programmers, those of Stage IV, will not simply latch onto whatever happens to be around, with or without justification, but will have a conception of what it is that they value, and will then seek an explicit theory, or a combination of such theories, to help realize this system of values. Stage IV programmers realize that the use of an explicit theory to help identify the gifted automatically makes a statement not only about the construct(s) with which the theory or theories deal (such as intelligence or creativity), but also about what is valued by those who will make identification decisions.

3. **What kind of educational program is ideal for gifted children?** Debates about the best program for gifted children take on a different character when viewed from the standpoint of the pentagonal theory. There is no "right" answer to the question of what kind of program is best. Rather, we again need to ask ourselves what we value. If we value rapid learning, and believe that rapid learners will be in an enhanced position to contribute to our society, then acceleration makes sense. If we believe that what matters is the depth or care students take in probing into what they learn, enrichment will be preferable. If both are prized, we might use a combination. Whatever we do, we should ensure that the values expressed in the instructional program are the same as those expressed in the identification program. If we select for rapid learners, we ought to teach in kind. Once we clarify what we value, we should then act accordingly.

In conclusion, the pentagonal implicit theory provides a basis for understanding how people assign the label of giftedness to some individuals but not to others. It suggests the framework supporting such judgments, whereas explicit theories fill in possible and alternative contents. By understanding implicit as well as explicit theories, we obtain a better grasp of what giftedness might mean not only as specified by psychological or educational theorists, but by the people who day-to-day make decisions about giftedness. For they are theorists too, and those who most affect the lives of us and our children.

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